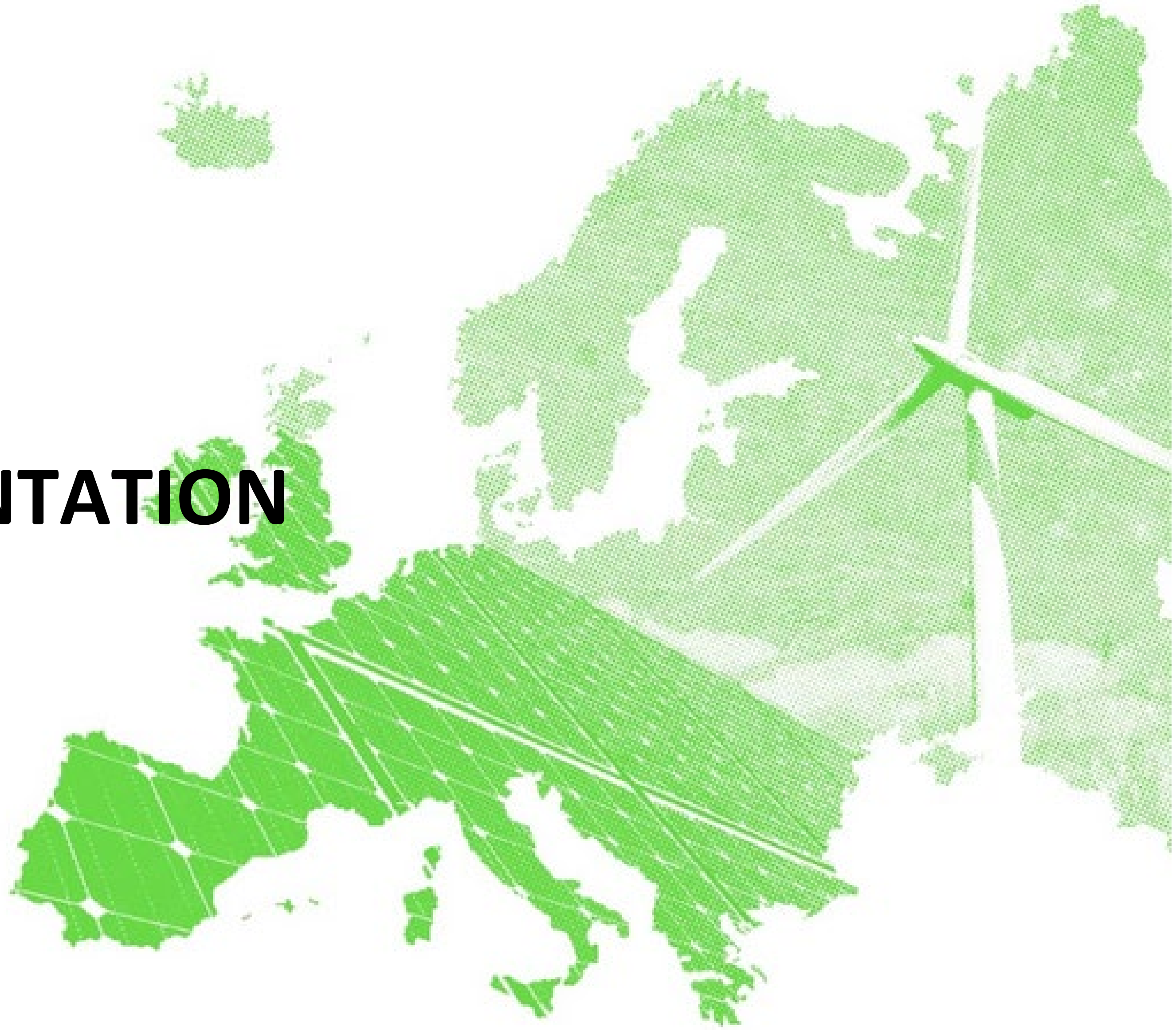
GREENTECH FINAL PRESENTATION
29/11/2024
Jonage, France

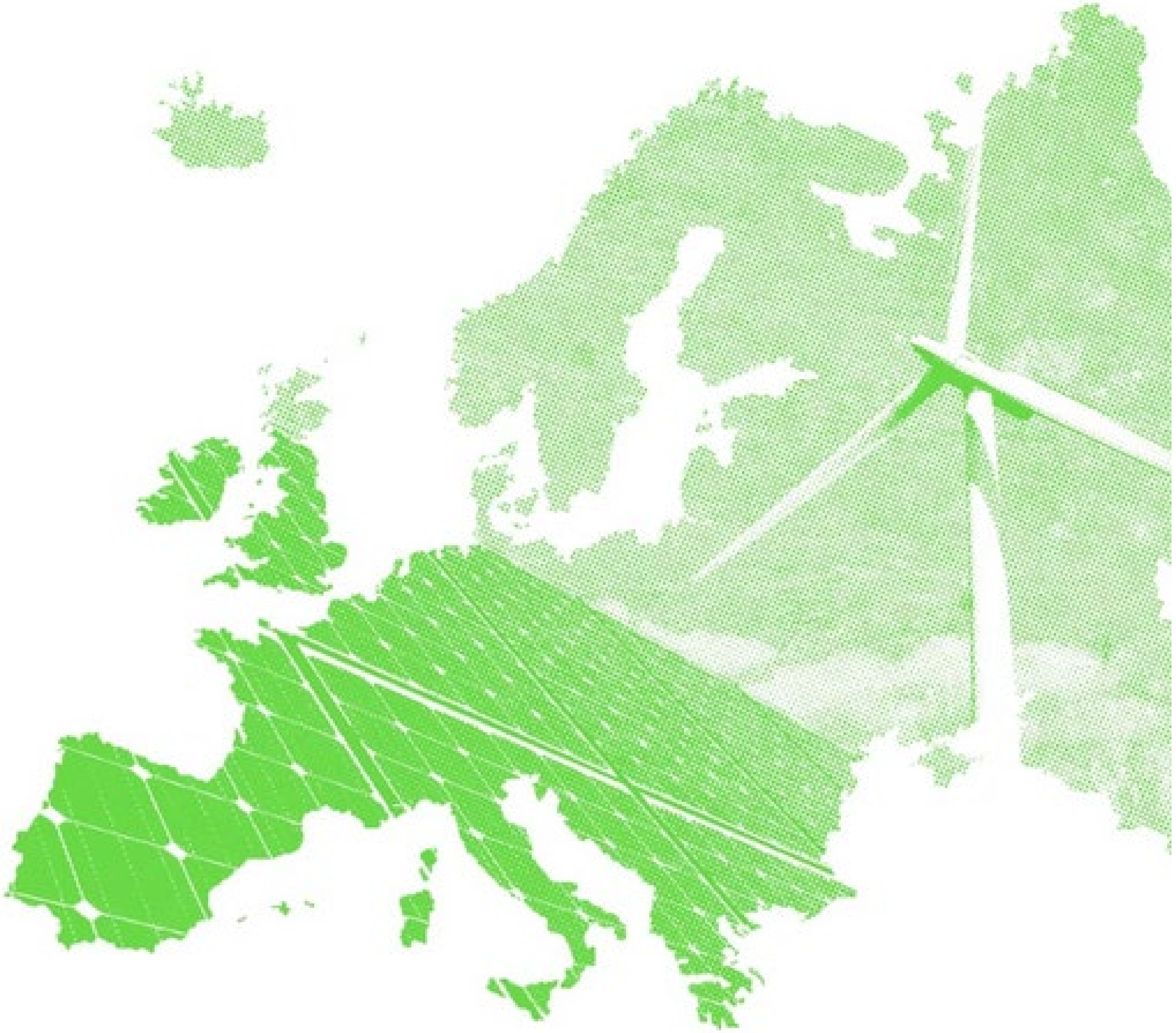


Agenda

- **Welcome Speech**
- **Presentation** of the GreenTech project
- **Round Table Discussion:** challenges and solution to reinforce initial and continuous training on renewable energies
- **Presentation of the GreenTech project results**
- **Conclusion** of the presentations
- **Speed meetings** Companies and Students **// Networking session**

WELCOME SPEECH

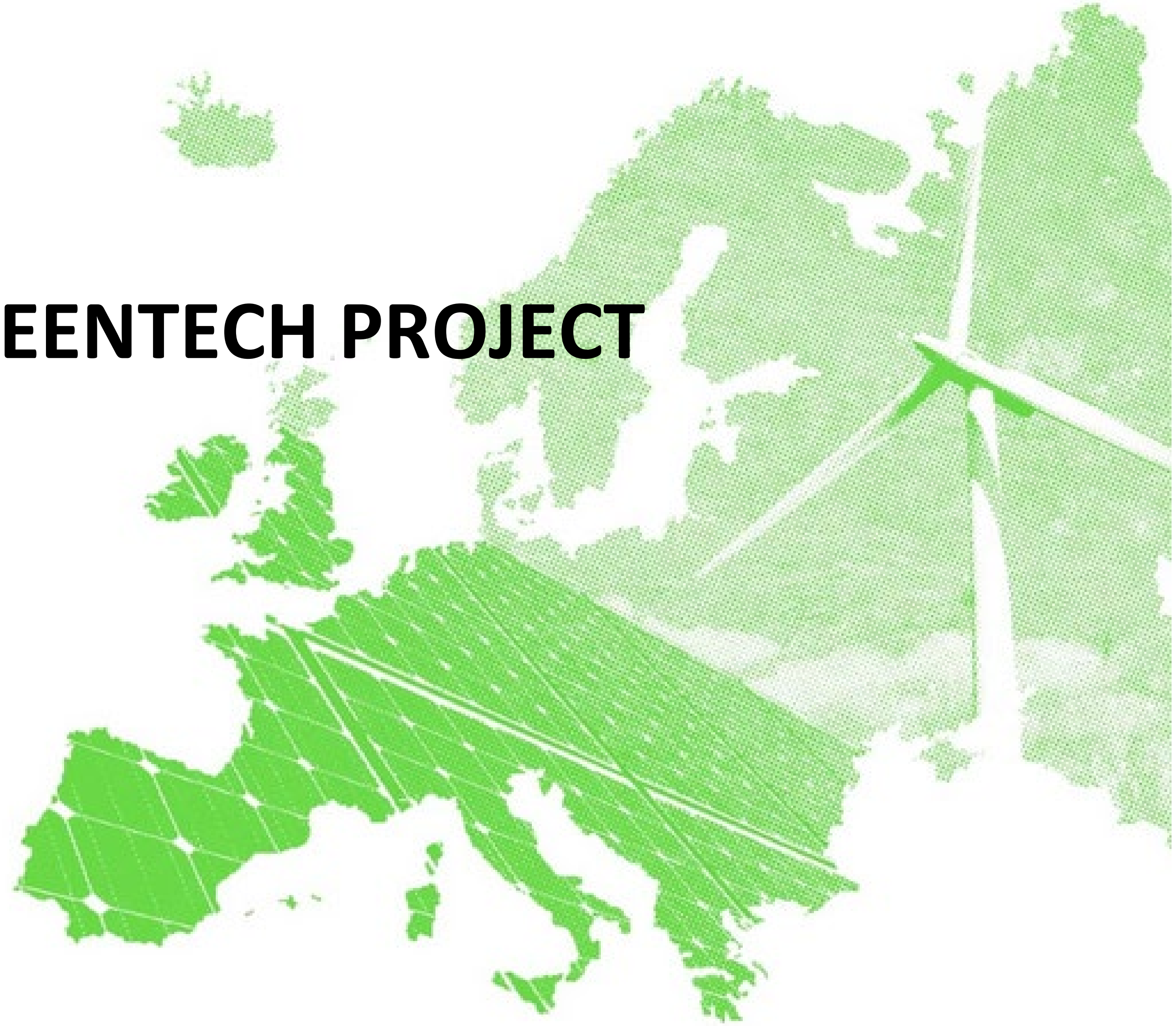
Vincent BRIAT



GREEN Tech

Erasmus+

PRESENTATION OF THE GREENTECH PROJECT



Nadia GONTHIER
Head of international service

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

GIP FIPAG
Académie de Grenoble

Anabelle MORICEAU
Executive director

CAMPUS DES MÉTIERS ET DES QUALIFICATIONS D'EXCELLENCE
Smart Energy Systems Campus
Auvergne-Rhône-Alpes

CAMPUS DES MÉTIERS ET DES QUALIFICATIONS D'EXCELLENCE
Smart Energy Systems Campus
Auvergne-Rhône-Alpes

RÉPUBLIQUE FRANÇAISE
Liberté
Égalité
Fraternité

GIP FIPAG
Académie de Grenoble

KBA Nijmegen

PANEVĖŽIO KOLEGIJA

UCLL HOGESCHOOL

xaBec
CENTRO DE FORMACIÓN PROFESIONAL

IUT1A
Université Grenoble Alpes

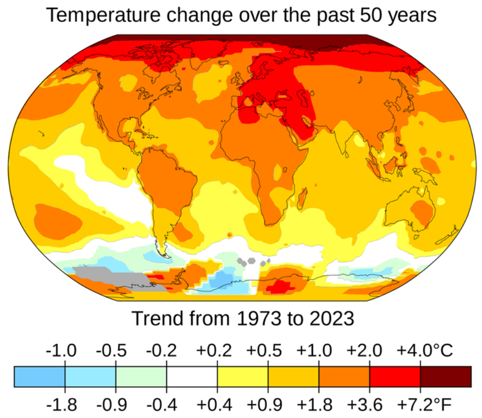
Tenerrdis
Auvergne-Rhône-Alpes

Context

Climate change and zero carbon transition

New knowledge required / a more complex energy system

Importance to train more versatile technicians, with a whole picture



Lack of qualified manpower (maintenance technicians)

- **It is estimated that about 1.5 million highly skilled people must be trained every year in Europe in the renewables sector**
- **In France : 200 000 new jobs in electricity sector by 2030**

Objectives

Breaking down the barriers between individual energy system training courses

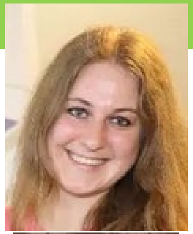
Create **training modules** for technicians dealing with the new energy mix

Help increase the number of **women** in training courses and professions

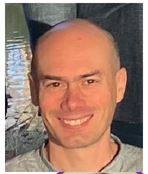
Consortium and project team

KBA
Erik KEPPELS

UCCL
Peter VAN HOUT

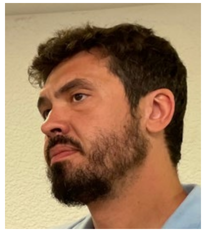


Panevezio Kolegija
Jovita KAZIUKONYTE
Remigijus KALIASAS

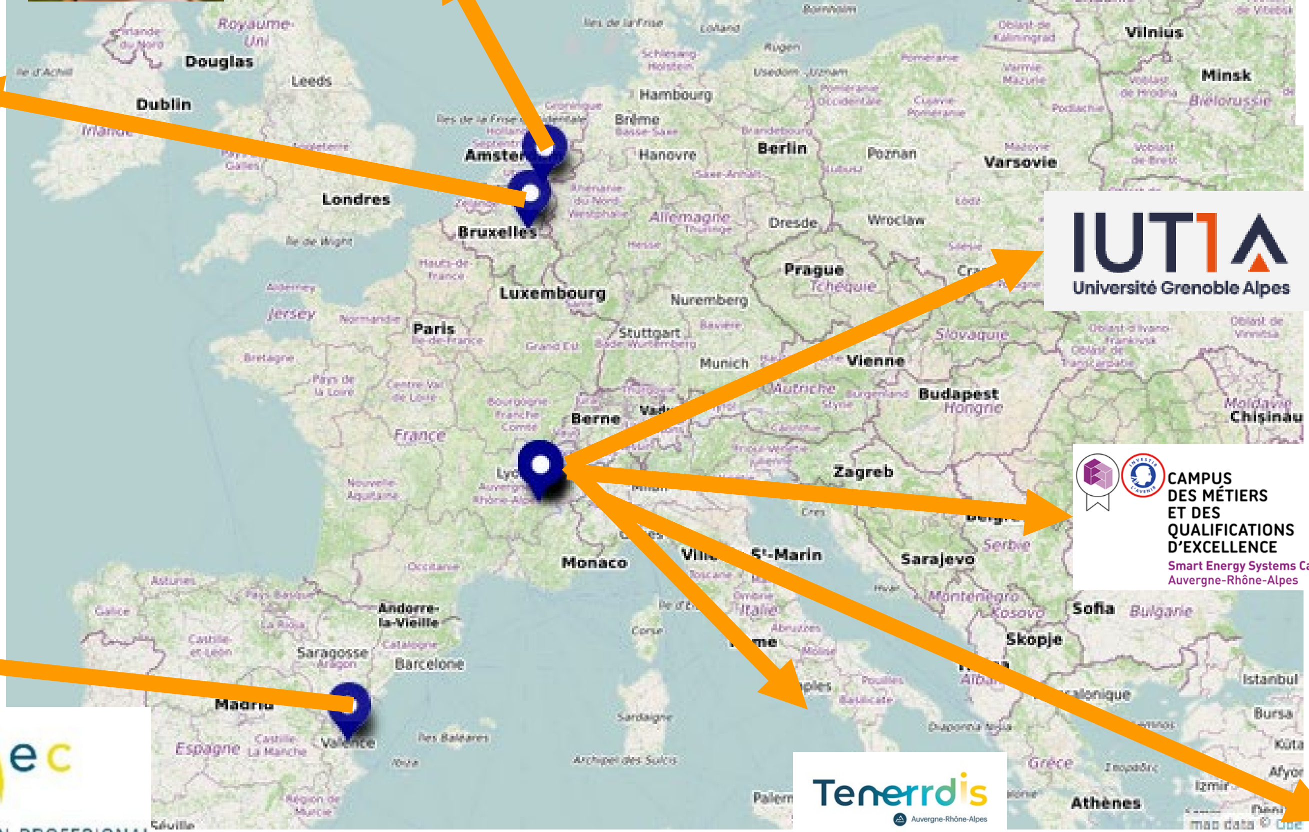


IUT1 - UGA
Cyril PICARD
Marion GERARD

Campus Smart Energy Systems
Michel BUREL
Anabelle MORICEAU



XABEC
Gregorio BLANCO SAEZ
Jose Manuel ALEGRE



TENERRDIS
Philippe CHUZEL

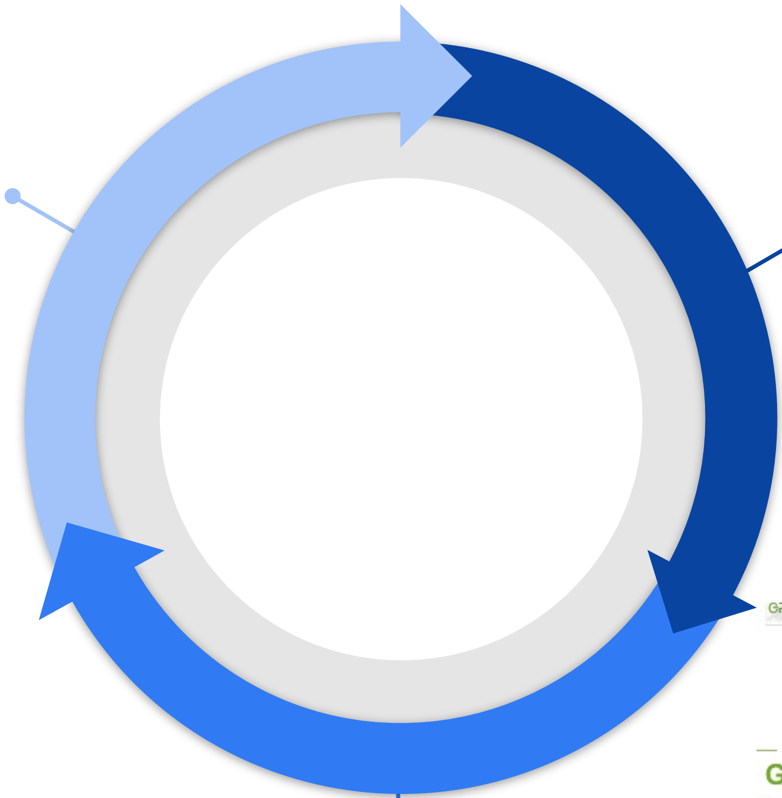
GIP FIPAG
Nadia GONTHIER

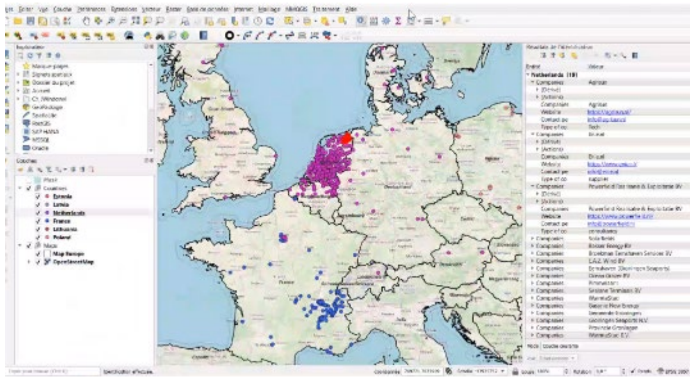
Internal

Upstream phase

Erasmus + project : the results must benefit the greatest number of people

STAKEHOLDERS MAPPING





SURVEY AND INTERVIEWS

WEBSITE

https://greentech-erasmus.eu/

Erasmus+

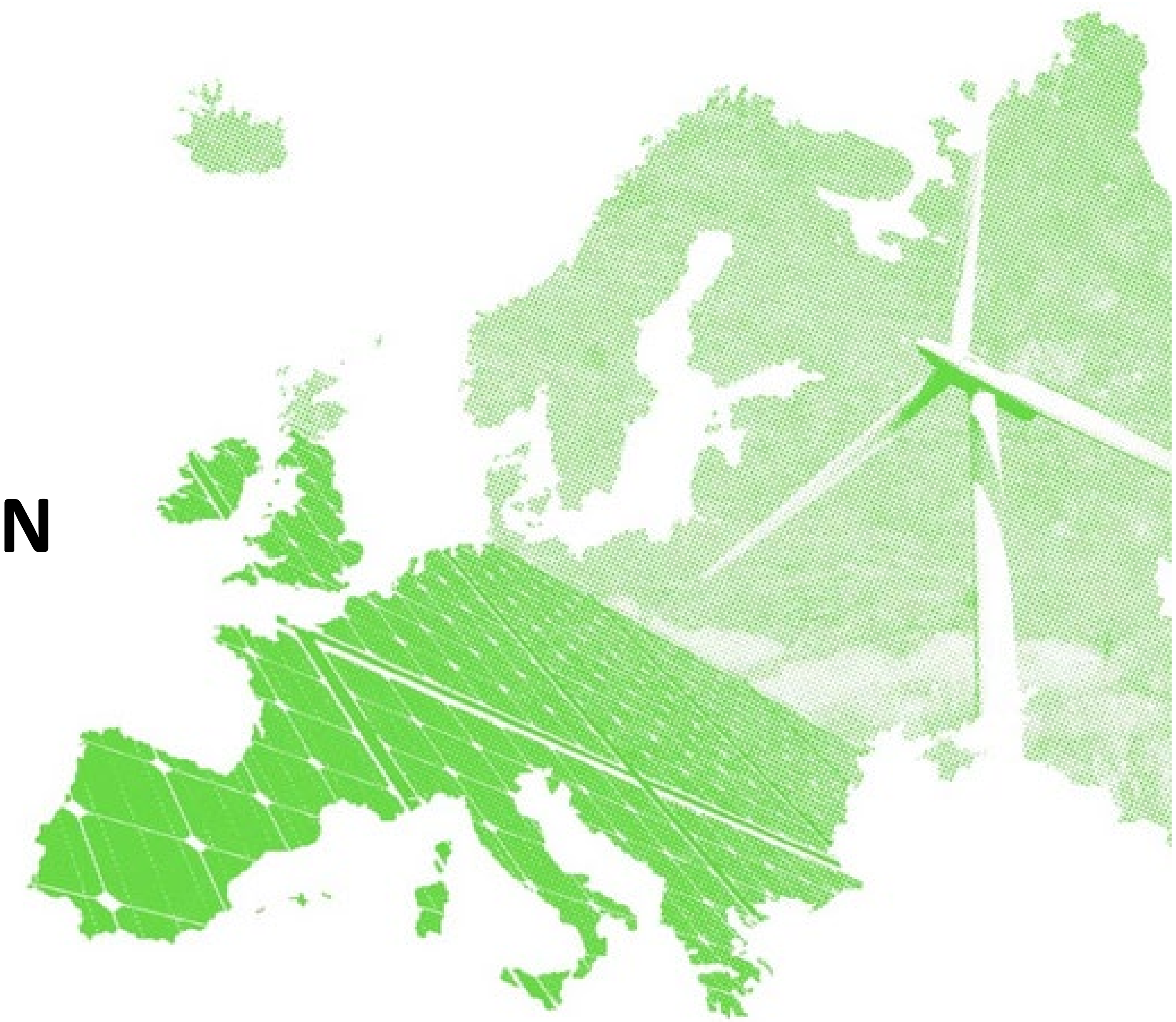
Training modules

- *Erasmus + project : the results must benefit the greatest number of people*
- *All modules have been reviewed by professionnals !*

M0	M1	M2	M3	M4	M5	MOOC
INTRO	SOLAR ENERGY	WIND ENERGY	NETWORK MANAGEMENT STORAGE	H2 GREEN PRODUCTION	USAGES	LEARNING

CIRCULAR ECONOMY

ROUND TABLE DISCUSSION



Round Table Discussion

Challenges and solution to reinforce initial and continuous training on renewable energies

Michel DEGANIS

RÉGION ACADÉMIQUE AUVERGNE-RHÔNE-ALPES
Liberté Égalité Fraternité

Gregorio BLANCO SÁEZ

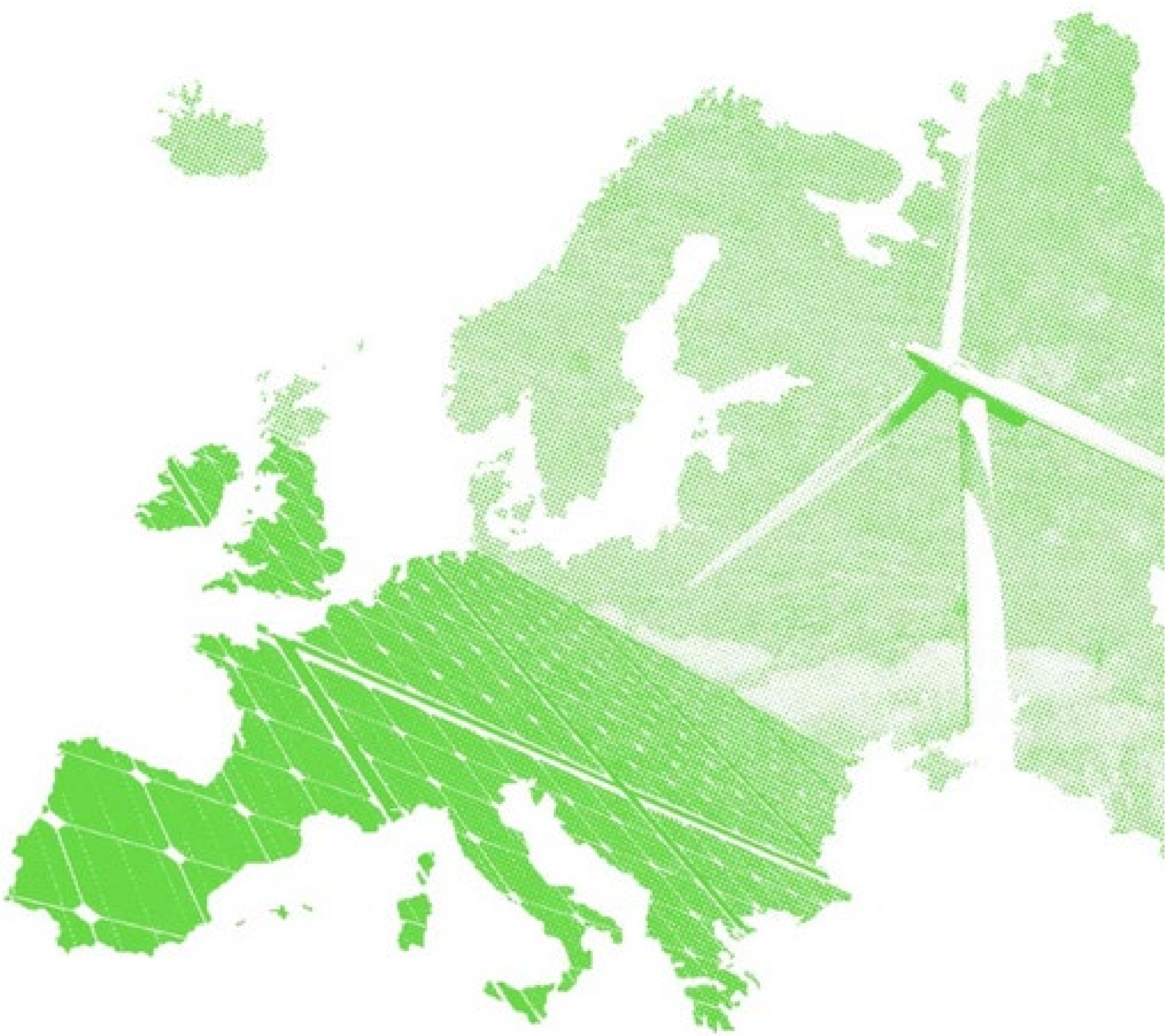
xaBec
CENTRO DE FORMACIÓN PROFESIONAL

Jean-Luc REBOUD

UGA Université Grenoble Alpes

G2Elab Grenoble Génie Électrique Grenoble Electrical Engineering

PROJECT’S RESULTS



Project's results

1. **How to access the resources**
2. **Modules presentation**
   - M1 : solar energy
   - M2 : wind energy
   - M3 : network management and storage
   - M4 : Hydrogen green production
   - M5 : Hydrogen usages

1. **First results and lessons learnt**
2. **Q&A**

How to access the resources

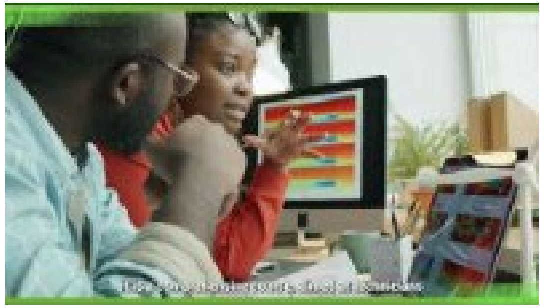
Developed course materials, for each module: LINK WEBSITE

- Descriptive sheet
- Course content + slideshow
- Video
- Evaluation quiz

MOOC, for each module: LINK CASEINE

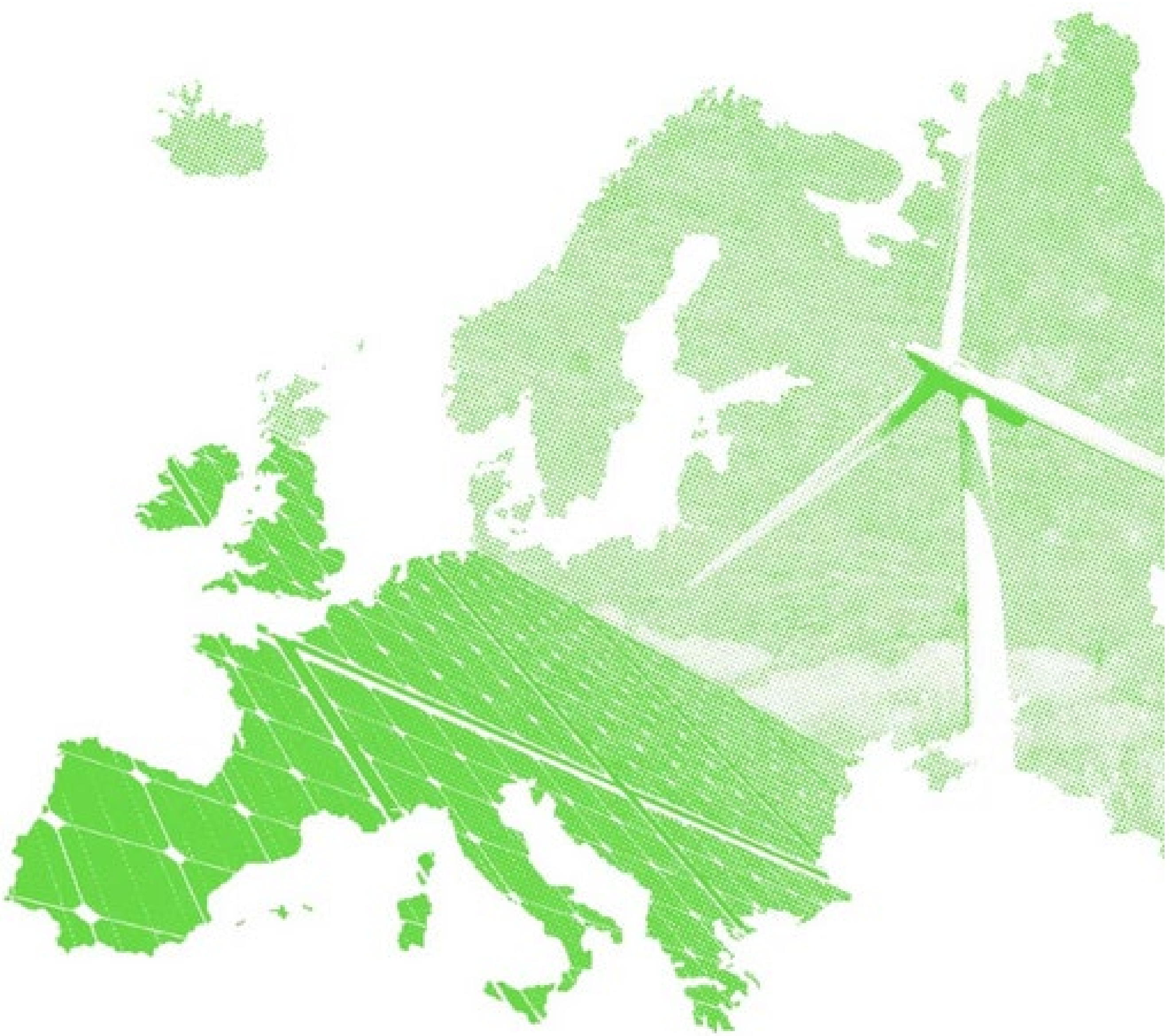
- Introductive videos
- Activity
- Descriptive sheet + course content + slideshow + videos
- Evaluation quiz
- Forum, Q&A…

MOOC TEASER



GREEN Tech Erasmus+

Modules presentation



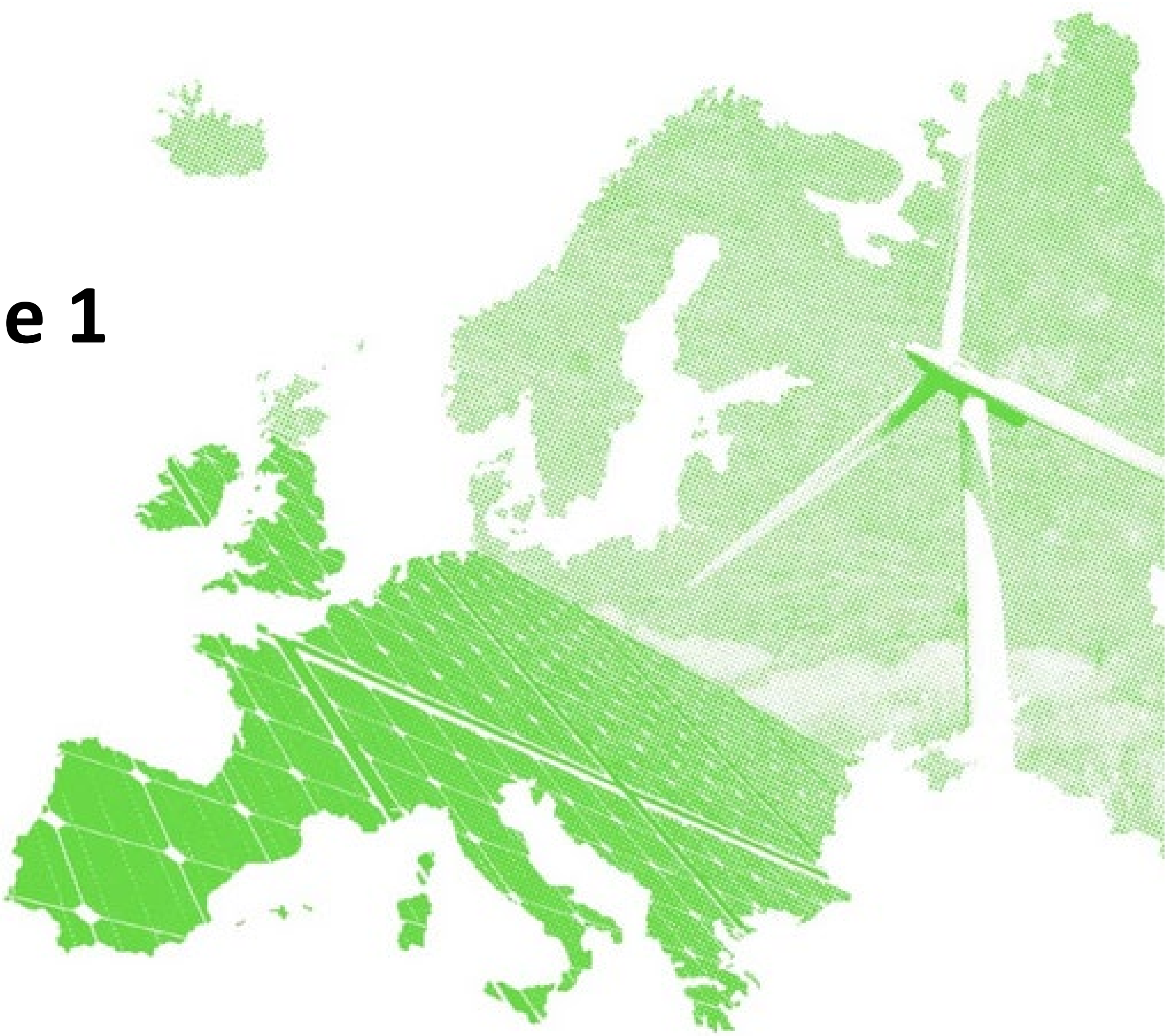
GREEN Tech

Erasmus+

GreenTech Project - Module 1
Solar Energy

PANEVĖŽIO KOLEGIJA

Remigijus KALIASAS



CAMPUS DES MÉTIERS ET DES QUALIFICATIONS D'EXCELLENCE
Smart Energy Systems Campus Auvergne-Rhône-Alpes

RÉPUBLIQUE FRANÇAISE
Liberté Égalité Fraternité

GIP FIPAG Académie de Grenoble

KBA Nijmegen

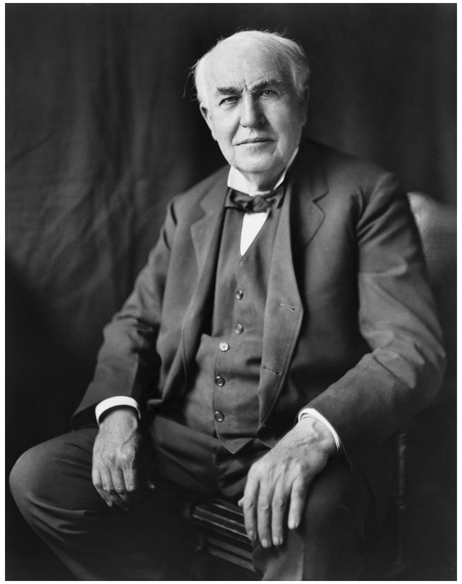
PANEVĖŽIO KOLEGIJA

UCLL HOGESCHOOL

xabec CENTRO DE FORMACIÓN PROFESIONAL

IUT1 Université Grenoble Alpes

Tenerrdis Auvergne-Rhône-Alpes



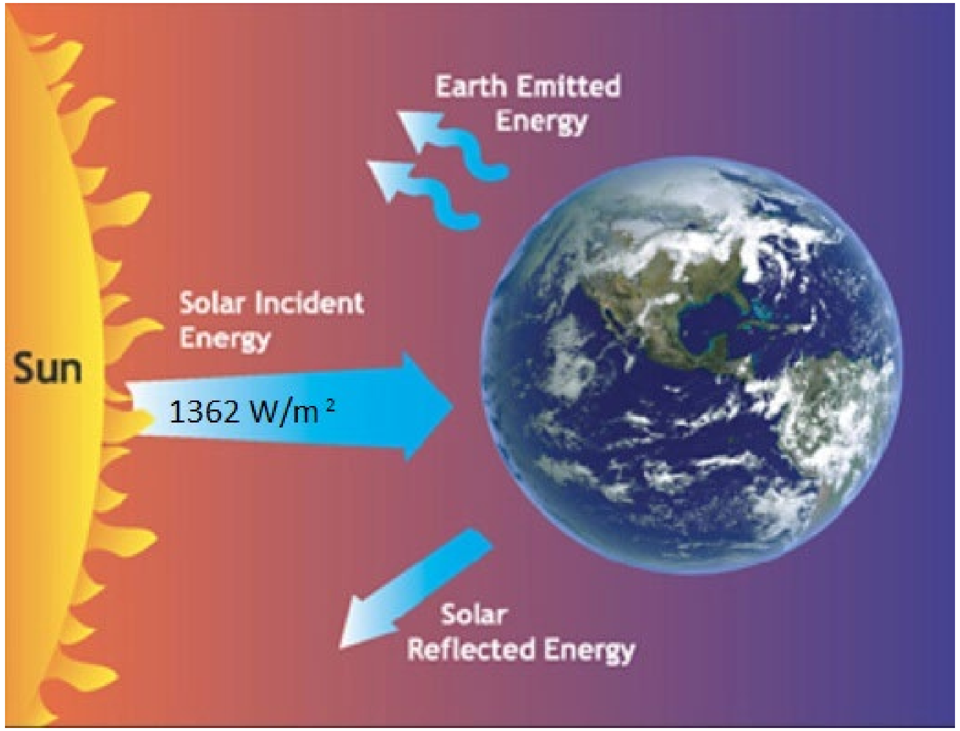
Thomas Edison, 1931

"I'd put my money on the sun and solar energy. What a source of power! I hope we don't have to wait until oil and coal run out before we tackle that."

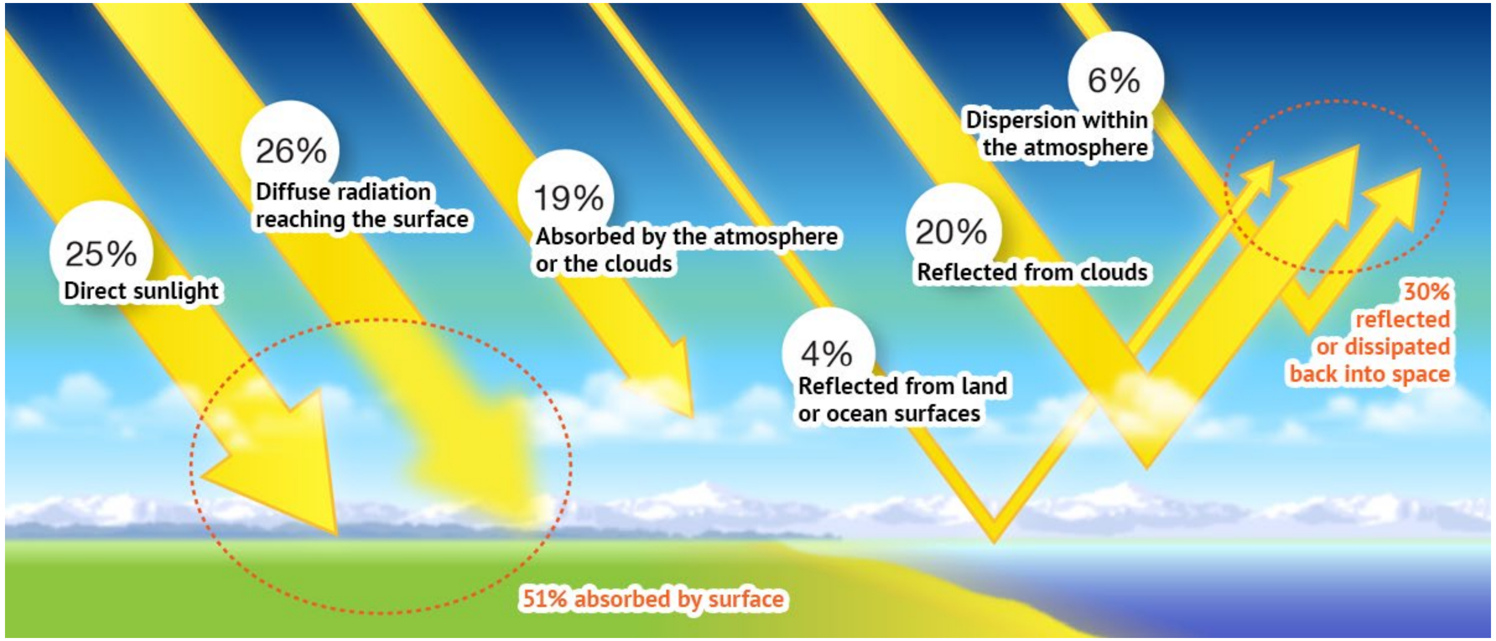
Content of the module

1. Solar energy
2. Solar photovoltaic technology (PV)
3. Solar water heating systems
4. Design example of solar plants
5. PV system monitoring
6. Installation and maintenance
7. Health and safety study
8. Circular economy

Solar energy

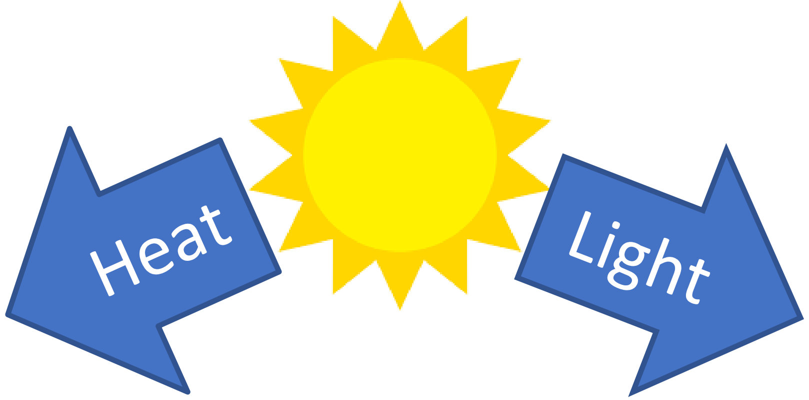


Solar energy flow



Solar energy

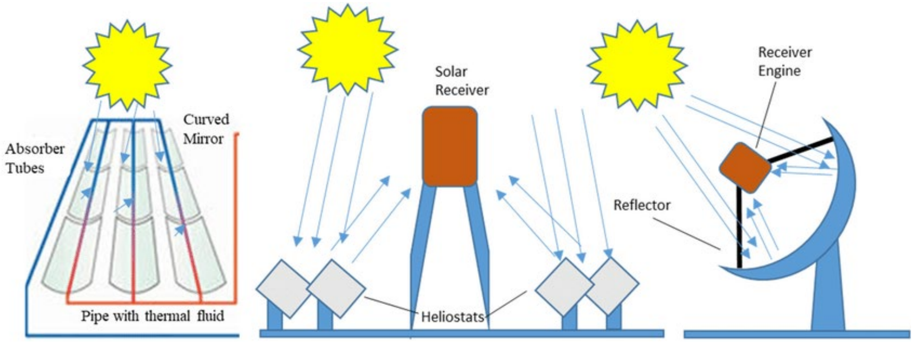
Solar thermal



Solar Photovoltaic (PV)

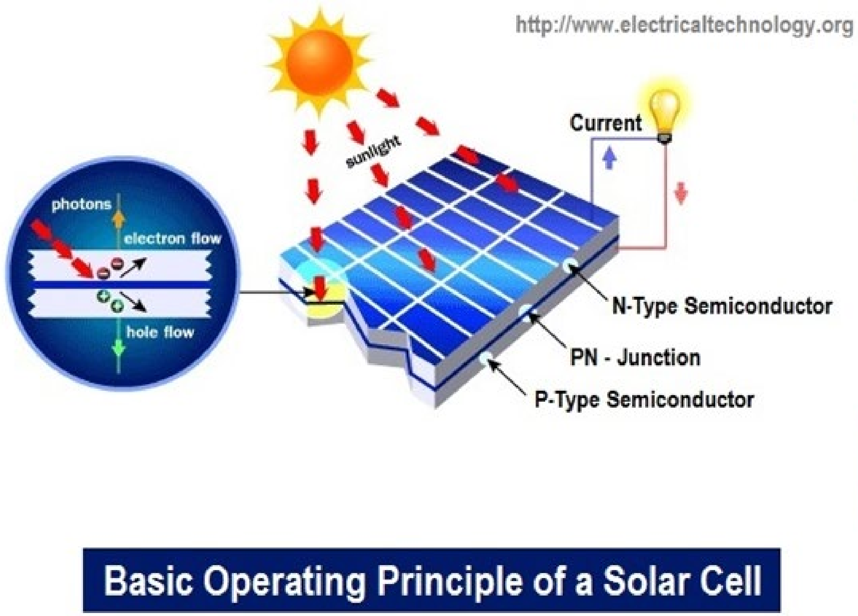
Concentration

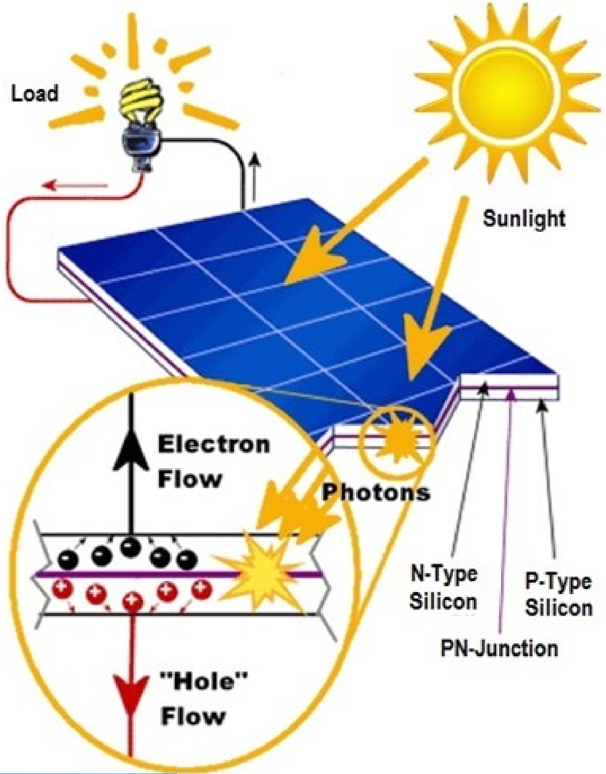
Concentrated Solar Power (CSP)



Concentrated Photovoltaic (CPV)

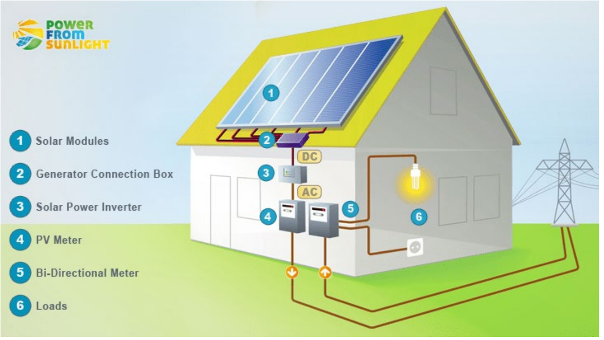
Solar photovoltaic technology (PV)



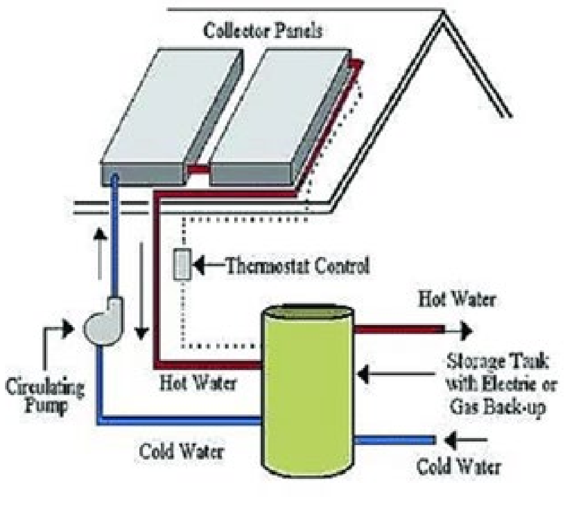


Photovoltaic (PV) systems convert light energy directly into electricity

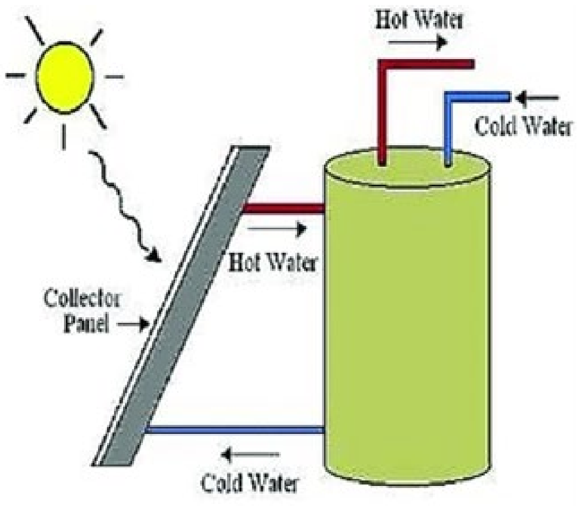
Commonly known as "solar cell"



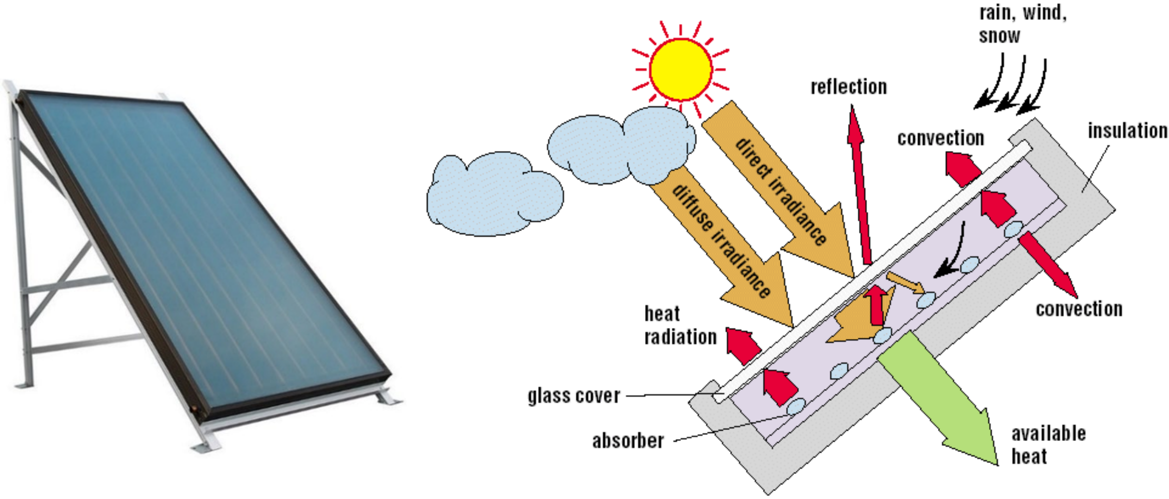
Solar water heating systems



(a)

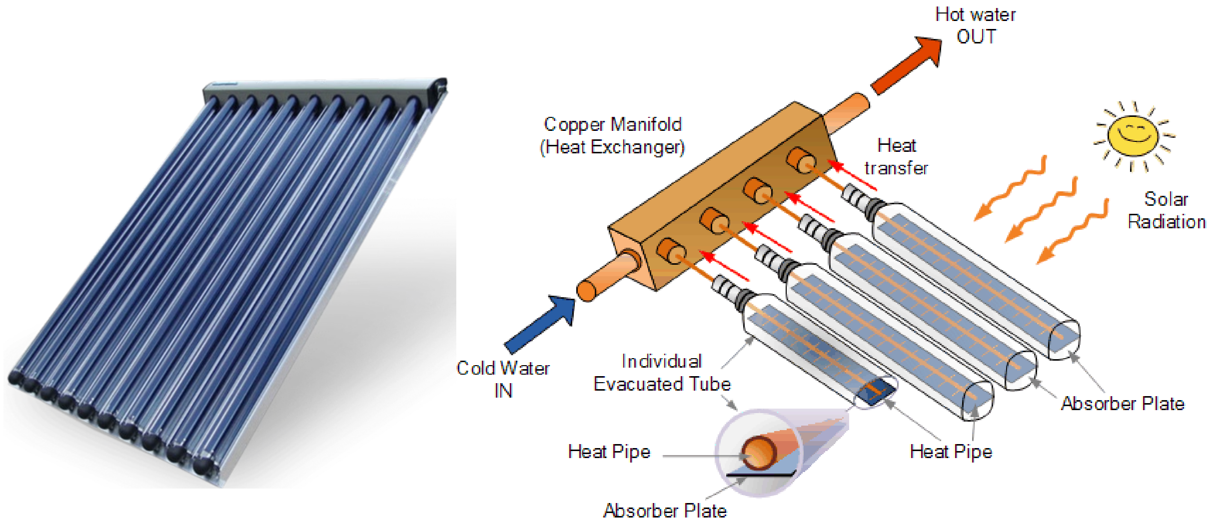


(b)



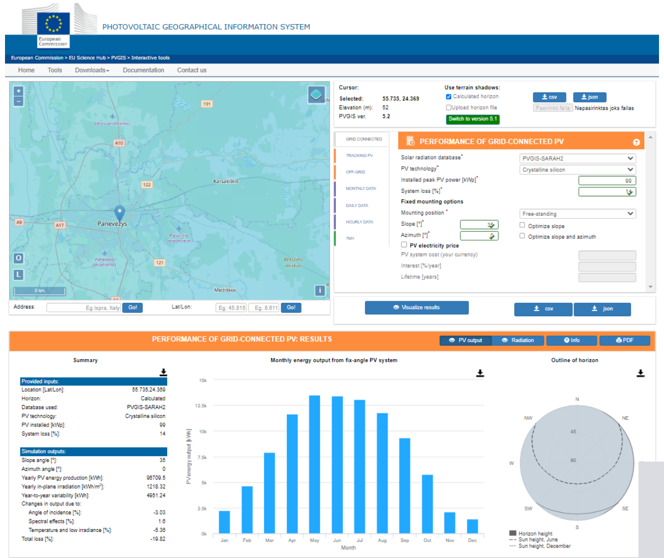
Solar thermal flat plate collector with working principle

a) Active type solar water heater system;
b) Passive type solar water heater system

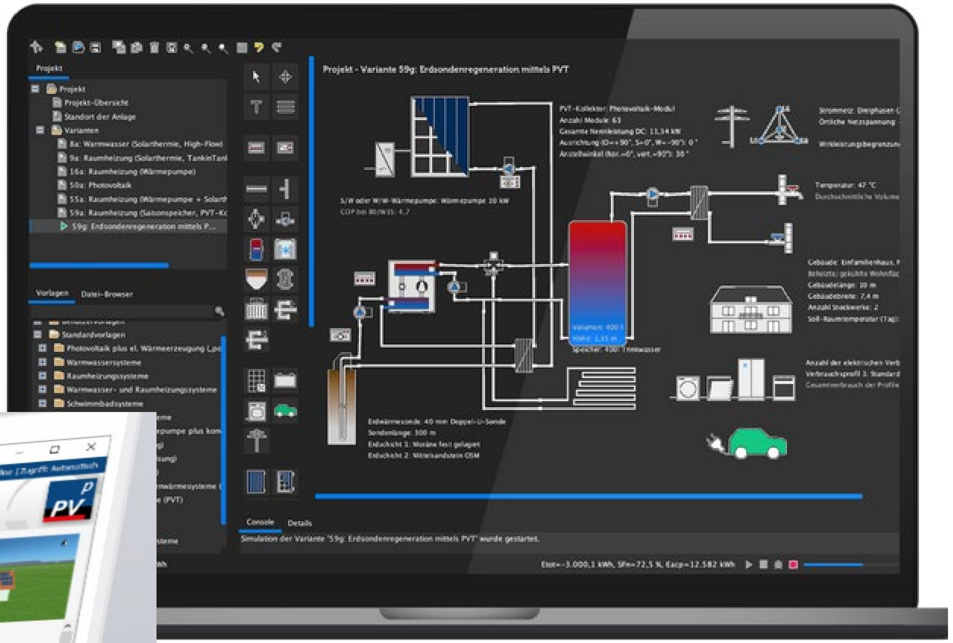


Evacuated tube solar collector with working principle

Design example of solar plants

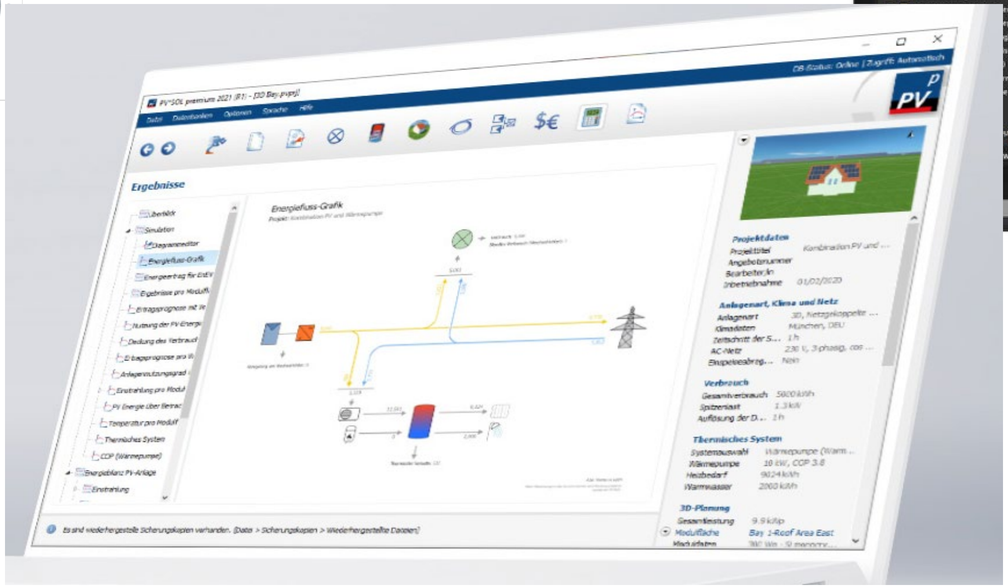


https://re.jrc.ec.europa.eu/pvg_tools/en/



Polysun

https://www.velasolaris.com/?lang=en



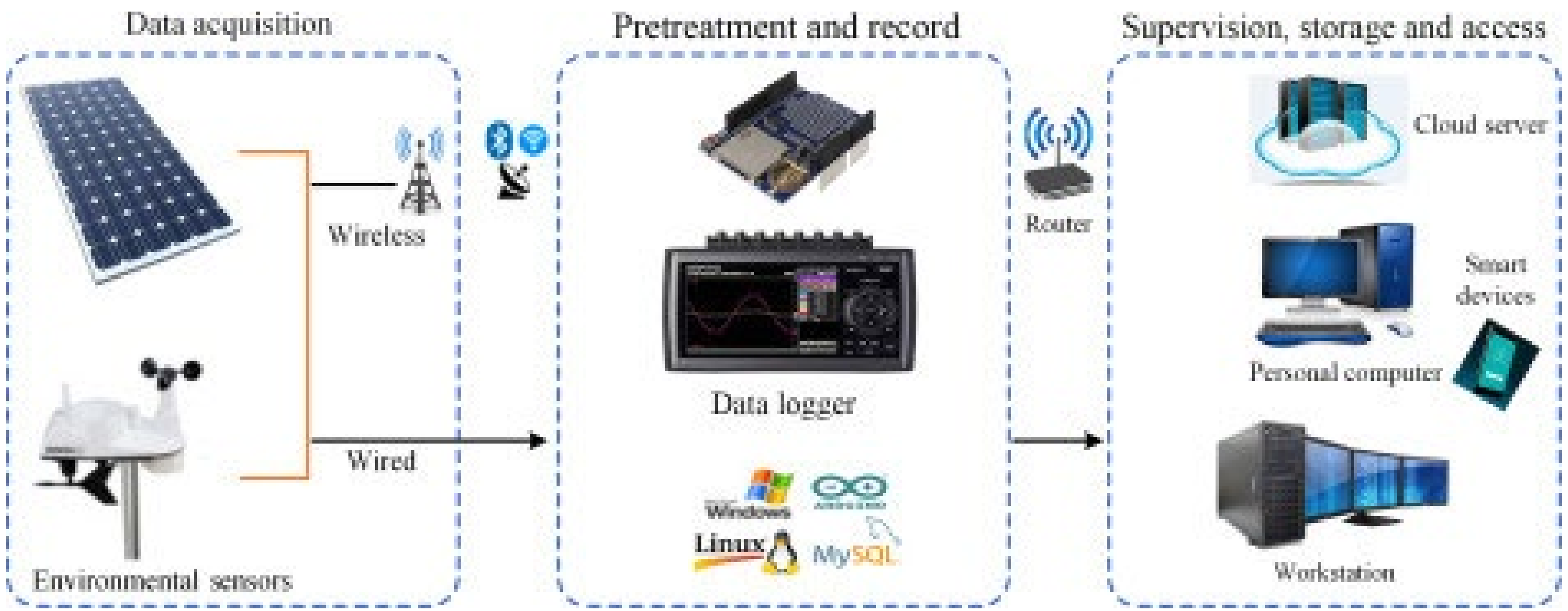
PVcase https://pvcase.com/#products.

Erasmus+

PV system monitoring

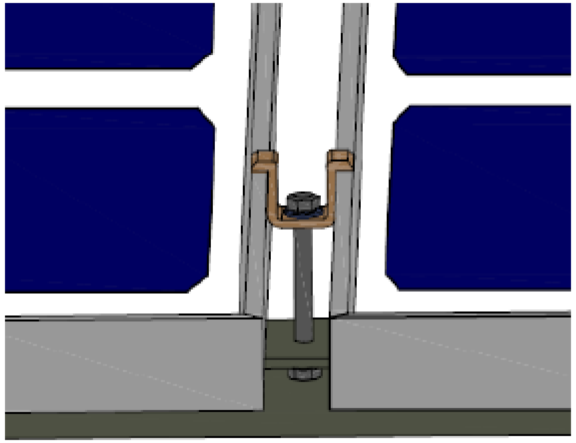
Electricity grid + communication

- Power plant to grid operator
- Grid operator to utility services
- Utility services to consumers
- Consumers to appliances

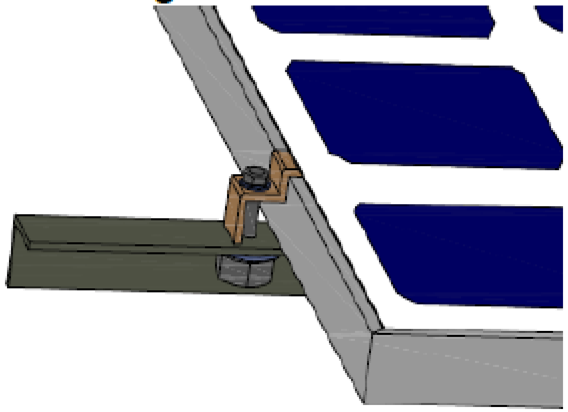


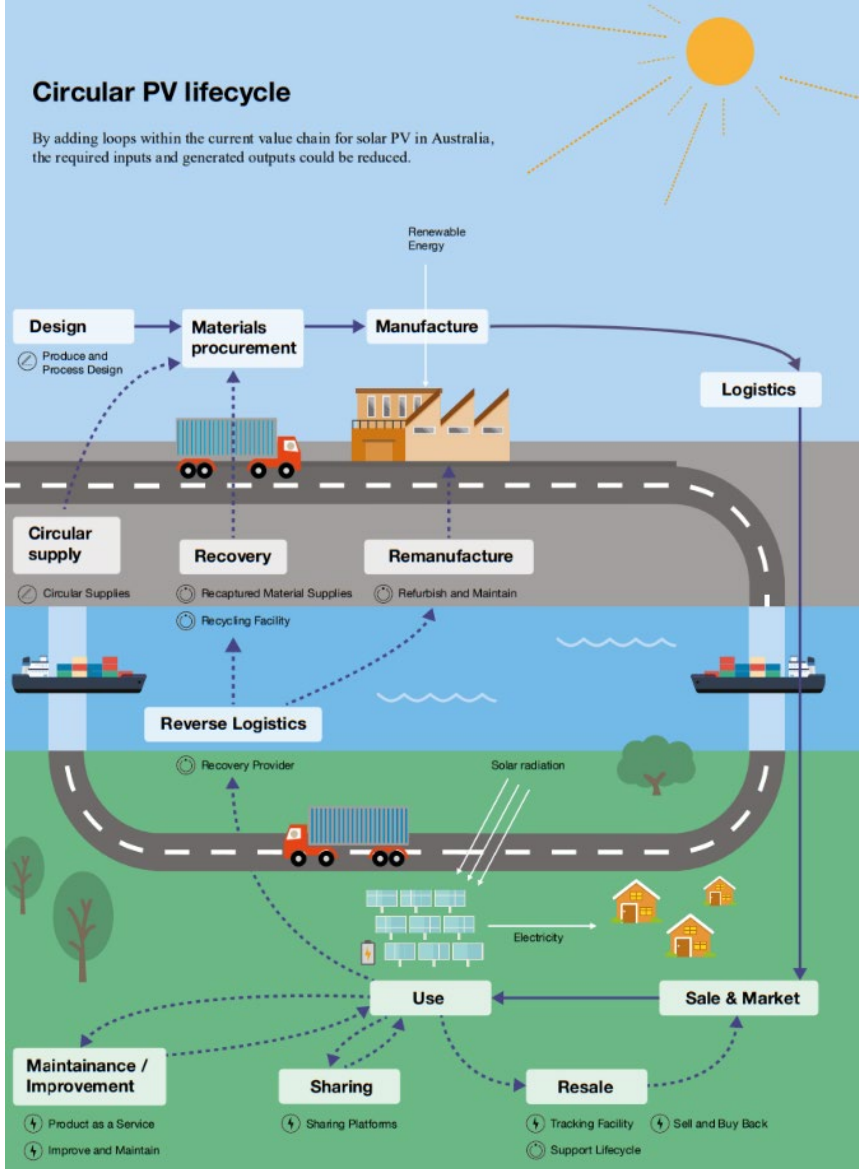
Installation, Safe Work, Circular Economy

Middle modules



Fringe modules





Erasmus+

Module testing in Lithuania

Module testing in France

Interview at SoliTek company

GreenTech project – Module 2
Wind Energy

CENTRO DE FORMACIÓN PROFESIONAL

Jose Manuel Alegre Cuenca

CAMPUS DES MÉTIERS ET DES QUALIFICATIONS D'EXCELLENCE
Smart Energy Systems Campus Auvergne-Rhône-Alpes

VOS COMPÉTENCES POUR DEMAIN

CENTRO DE FORMACIÓN PROFESIONAL

Content

M2 – Wind Energy

Content

1 - Background, current situation and expectations.

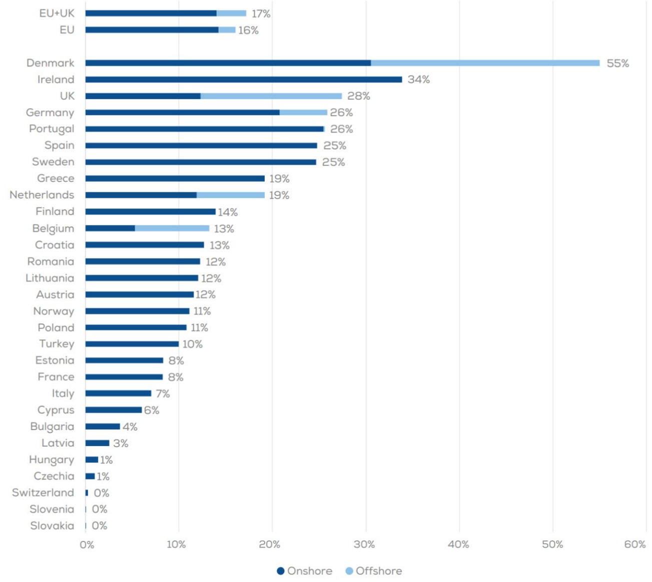


fig. 3: Percentage energy covered by wind in different countries. WindEurope (WindErope, 2023, 18)

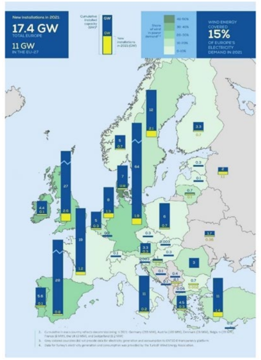
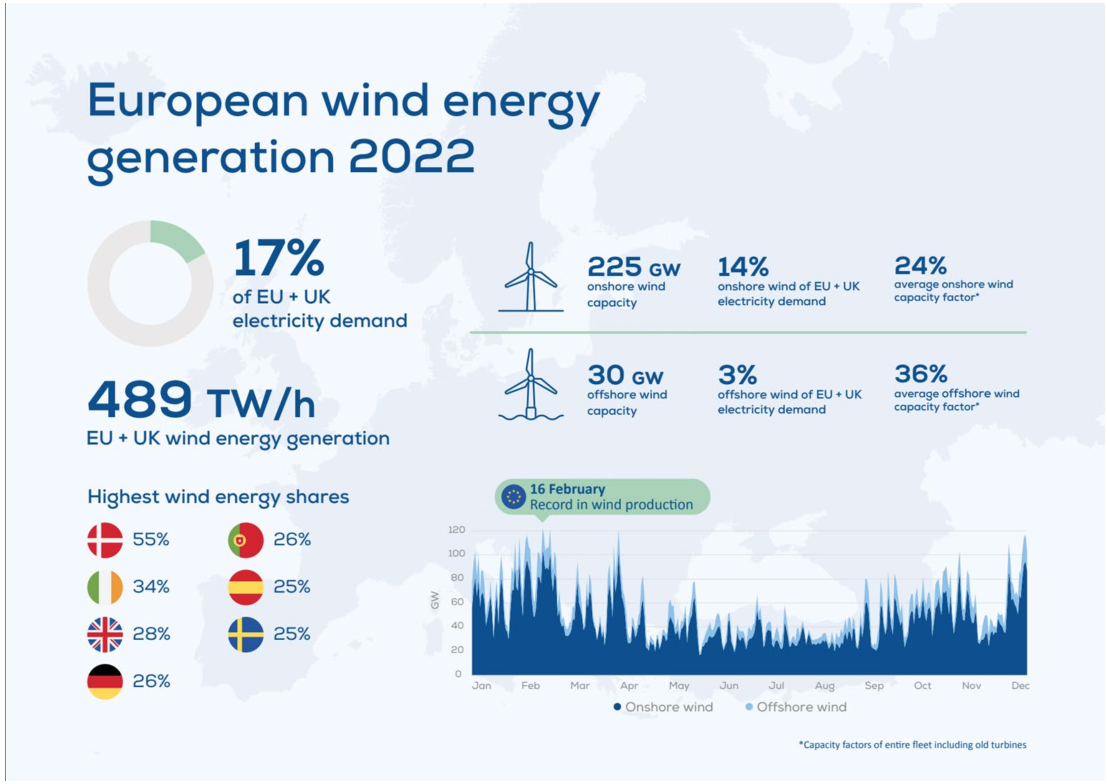
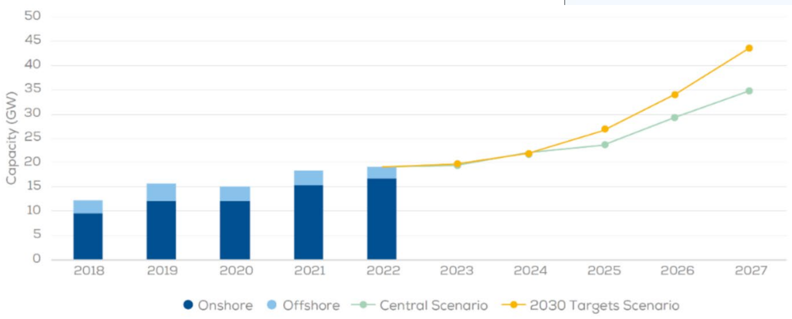


fig. 4: Energy production by countries. WindEurope (WindEurope, 2023, #)



New installations in Europe – WindEurope's scenarios



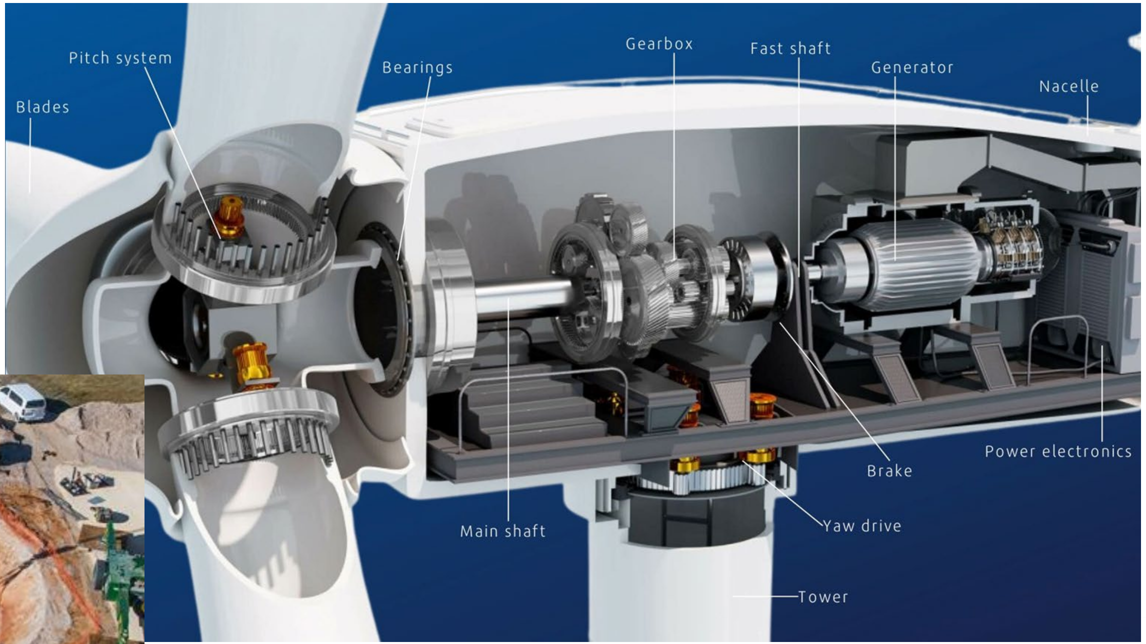
Source: WindEurope

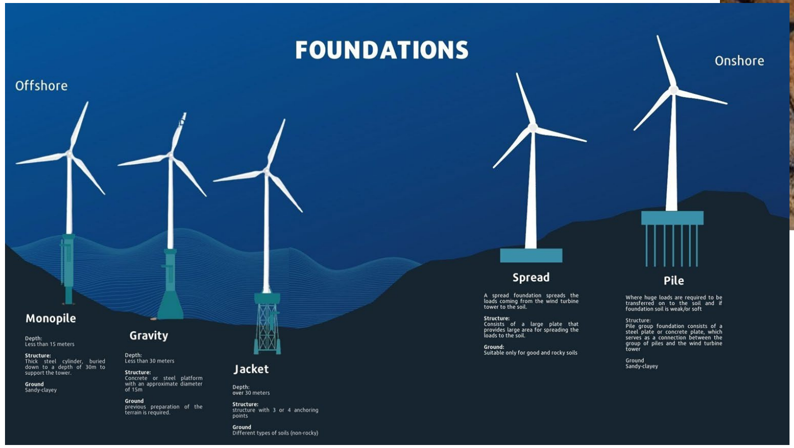
M2 – Wind Energy

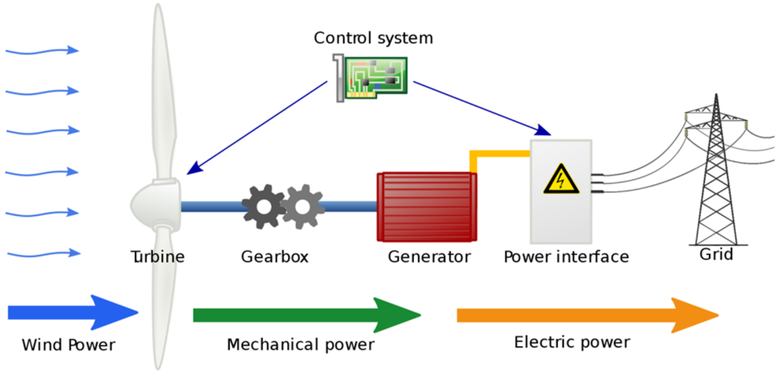
Content

2 - Wind turbine components and infrastructure.

- Description of a complete wind system.
- Types of installations.
- Wind turbines.
- Infrastructures







Content

3 - Maintenance.

fig. 44: Damaged terminals, hardware, and covers on rotor and stator leads (Velasco, n.d.)

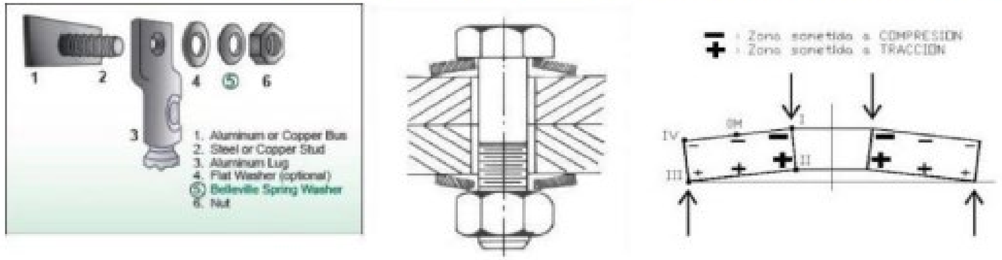


fig. 45 Belleville washers allow the preload to be maintained in the bolted joint despite the expansions suffered by the metal due to temperature changes

fig. 42: Ground track and brushes damaged by shunt. (Velasco, n.d.)

Content

4 - Design example.

17. BUDGET

The material execution budget of this project amounts to the amount of

TWENTY-FIVE MILLION SIX HUNDRED FIFTY-FOUR THOUSAND TWO HUNDRED FOUR EUROS AND SEVENTEEN EURO CENTS (€25,654,204.17)

Below is a summary of the different games:

VALDELANAVE WIND FARM SECOND PHASE 36MW

GENERAL BUDGET

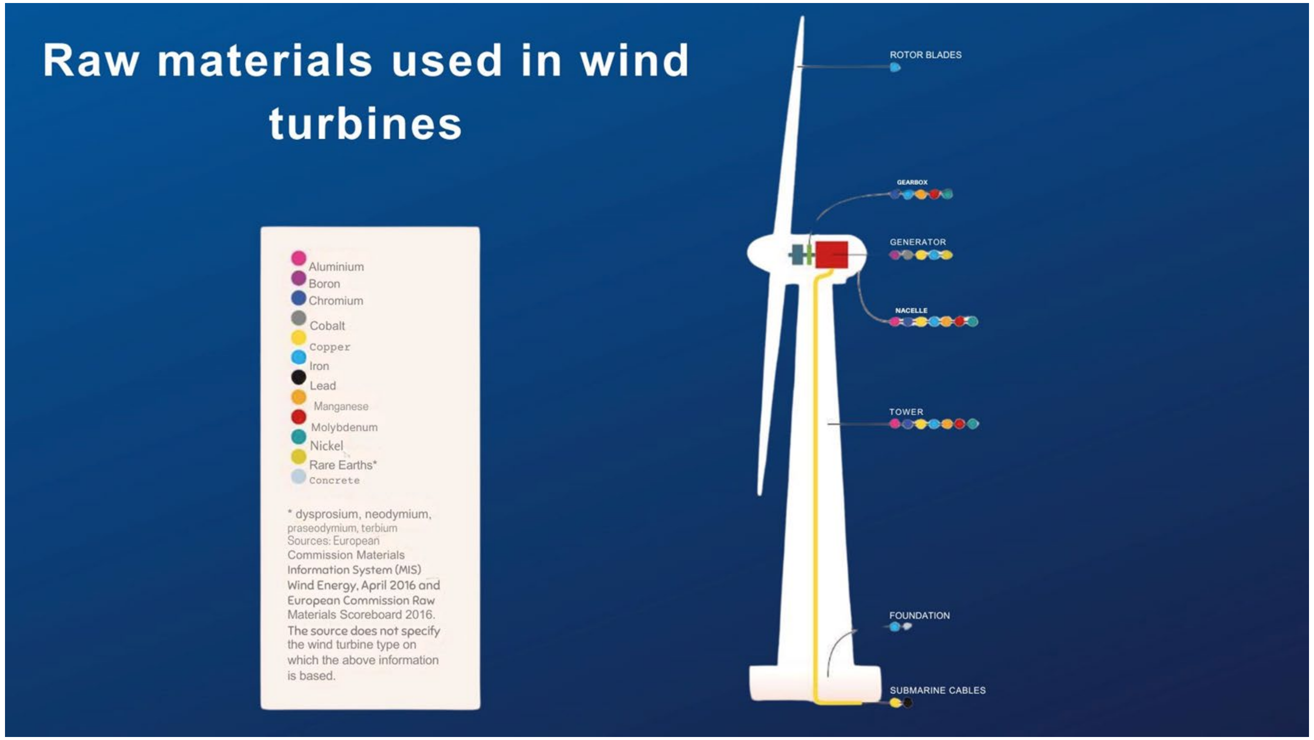
1.- WIND TURBINE SUPPLY	**22,926,531.60**
1.01 SUPPLY AND ASSEMBLY OF WIND TURBINES	22,799,880.00
1.02 SUPPLY AND ASSEMBLY OF MEDIUM VOLTAGE CELLS	126,651.60
2.- CIVIL WORKS	**2,350,449.90**
2.01 ACCESS ROADS, junctions and GRAL 2.02. INTERNAL	389,369.65
ROADS AND PLATFORMS	966,803.27
2.03 WIND TURBINE AND TOWER FOUNDATIONS	866,652.18
2.04 MV LINE CANALIZATION	127,624.80
3.- ELECTRICAL INSTALLATIONS 3.01	**219,211.08**
ELECTRICAL SUPPLIES	127,328.85
3.02 MV NETWORK	12,448.33
3.03 PAT NETWORK	26,407.80
3.04 COMMUNICATIONS NETWORK	17,526.10
3.05 MV NETWORK TESTS	34,000.00
3.06 MV NETWORK START-UP	1,500.00
4.- HEALTH AND SAFETY / QUALITY CONTROL	**42,361.59**
4.01 HEALTH AND SAFETY / QUALITY CONTROL	42,361.59
5.- WASTE MANAGEMENT 5.01	**115,650.00**
WASTE MANAGEMENT	115,650.00
TOTAL EXECUTION MATERIAL	**25,654,204.17**
GENERAL EXPENSES 13%	**3,335,046.54**
INDUSTRIAL PROFIT 6%	**1,539,252.25**
TOTAL BID BASE	**30,528,502.97**

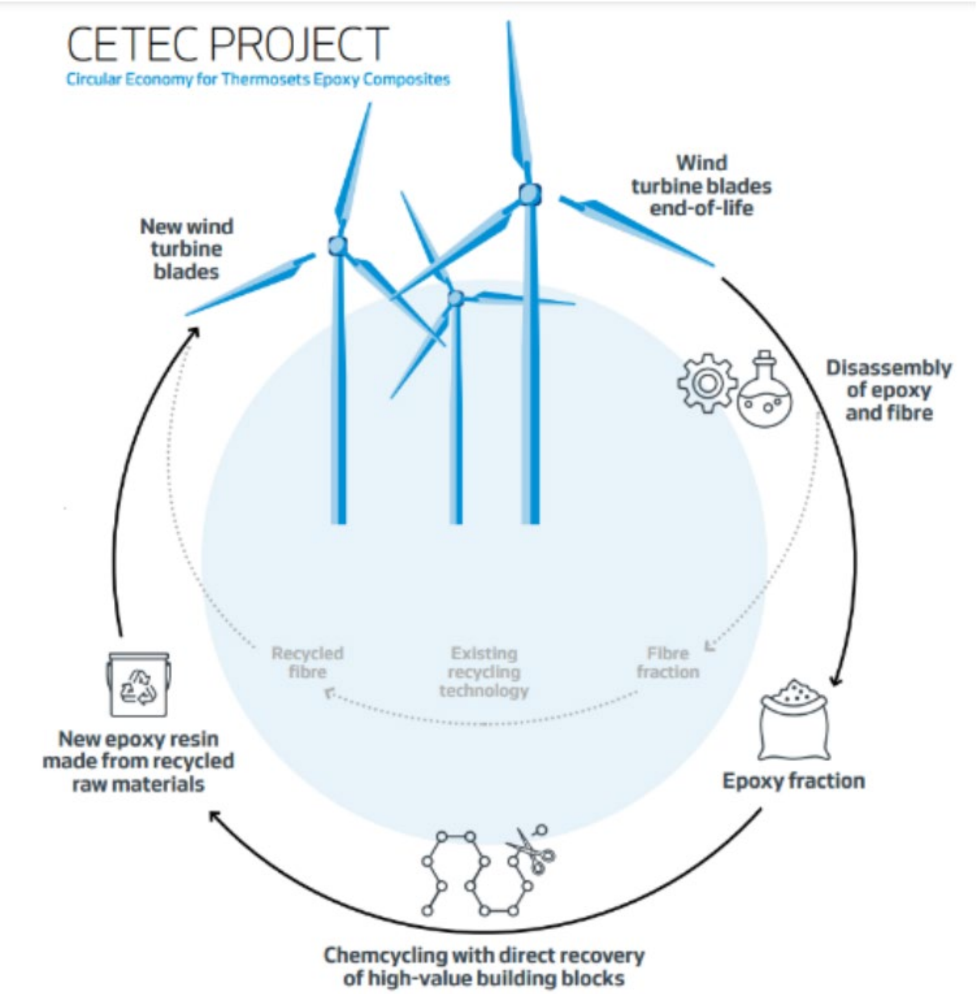
Table 9 Total budget

M2 – Wind Energy

Content

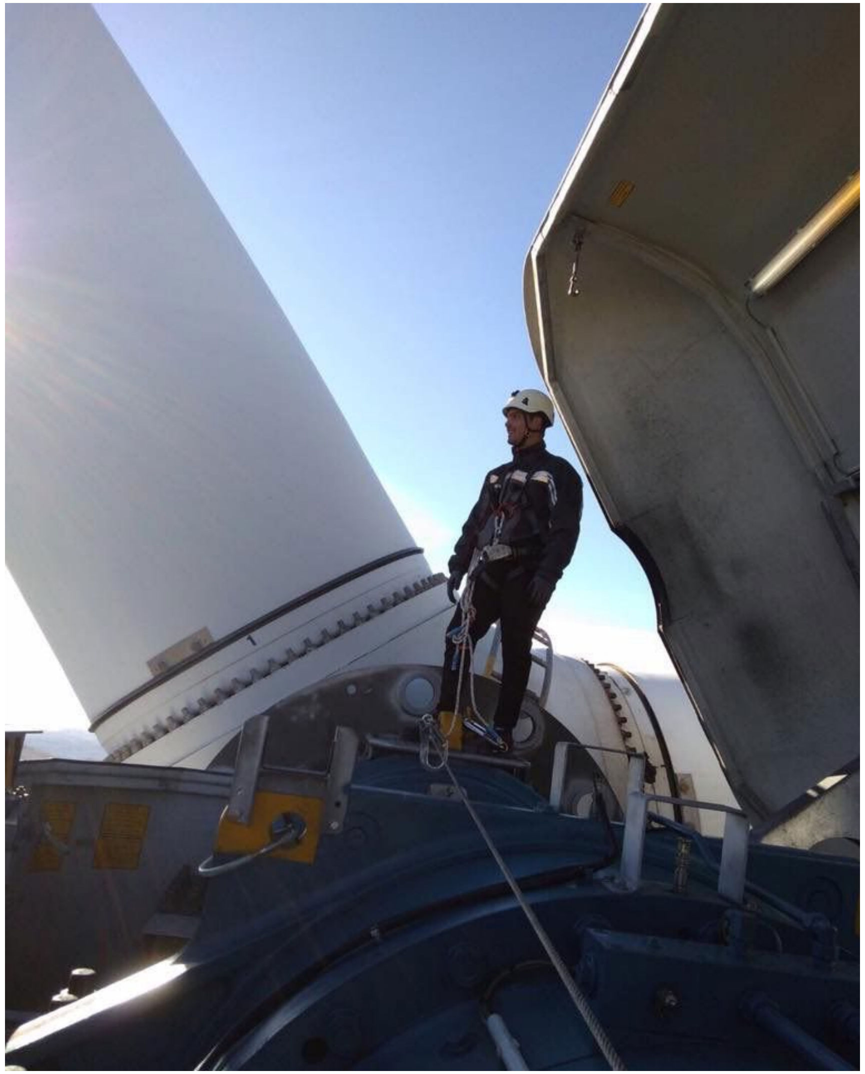
5 - Circular economy.





M2 – Wind Energy

Labs, demos & interviews



M2 – Wind Energy

Labs, demos & interviews

M2 – Wind Energy

Labs, demos & interviews

GreenTech

Erasmus+

GreenTech project – Module 3
Network management and storage

Peter VAN HOUT

UCLL HOGESCHOOL

CAMPUS DES MÉTIERS ET DES QUALIFICATIONS D'EXCELLENCE
Smart Energy Systems Campus Auvergne-Rhône-Alpes

académie Grenoble
RÉGION ACADÉMIQUE Auvergne-Rhône-Alpes

GIP FIPAG
VOS COMPÉTENCES POUR DEMAIN

KBA Nijmegen

PANEVĖŽIO KOLEGIJA

UCLL HOGESCHOOL

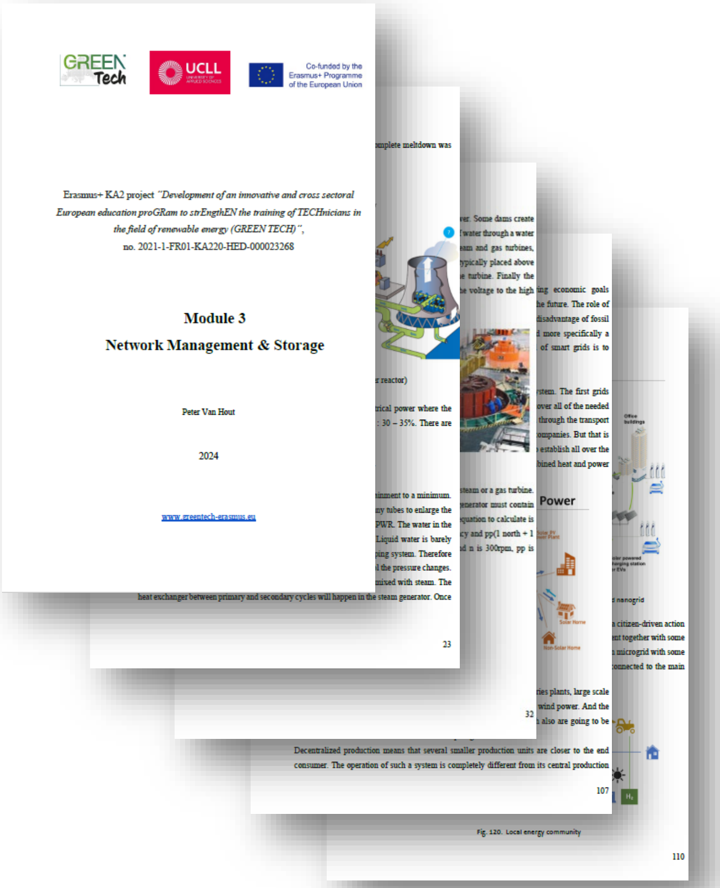
xaBec
CENTRO DE FORMACIÓN PROFESIONAL

UGA Université Grenoble Alpes

Tenerrdis
Auvergne-Rhône-Alpes

M3 – Network management and storage

Written course - pdf

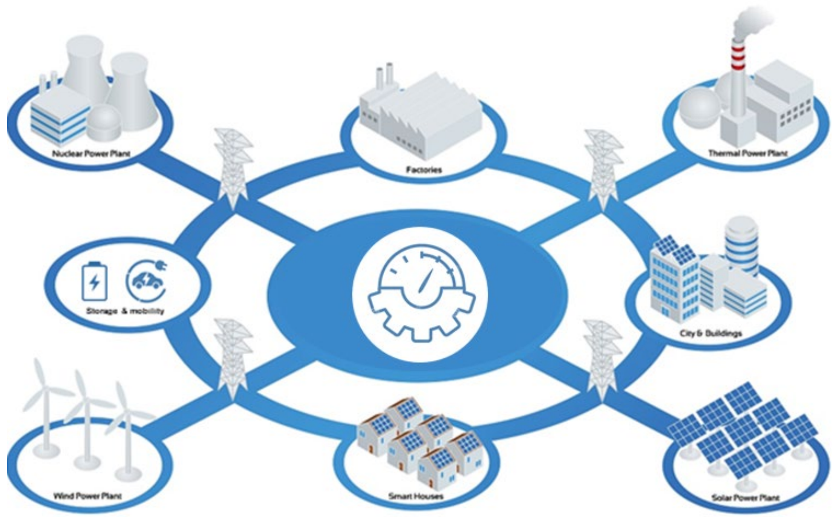


Presentation - pptx

Video - YouTube

MOOC Content

- Generating electrical energy
- Transmission & Distribution
- Energy storage concepts
- Energy Management Systems



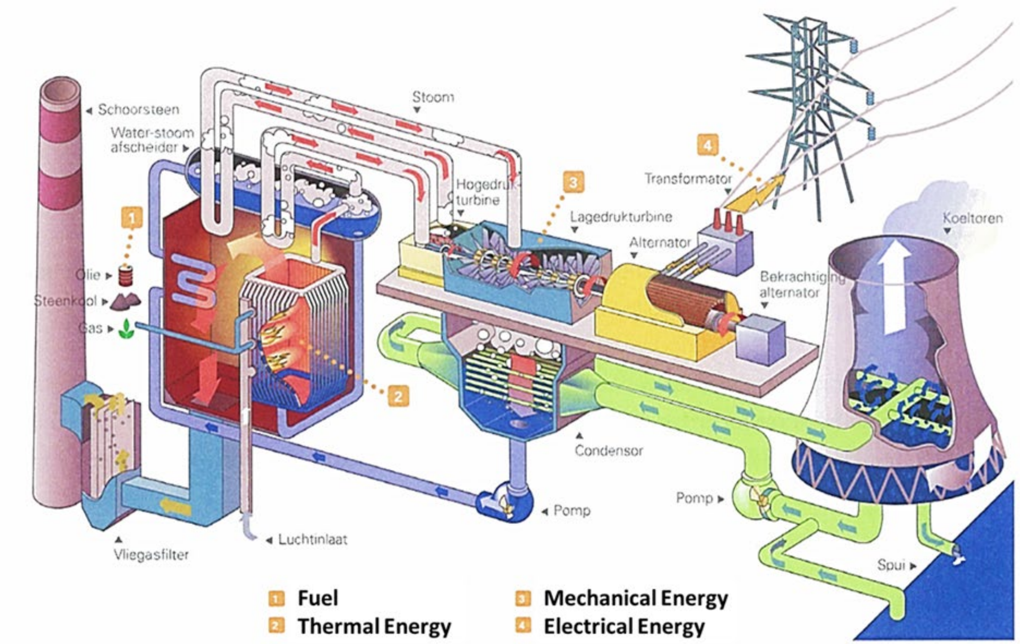
M3 – Network management and storage

1. Generating electrical energy

- Forms of energy
- Classic Production Plants : thermal, nuclear, CCGT, CHP
- Renewables : PV, wind, hydropower, H2 fuel cells

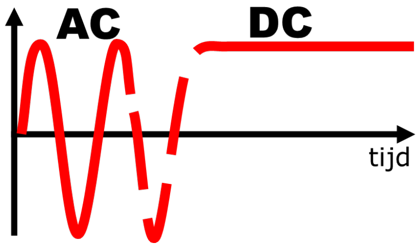
<u>Today's Lesson !!!</u>

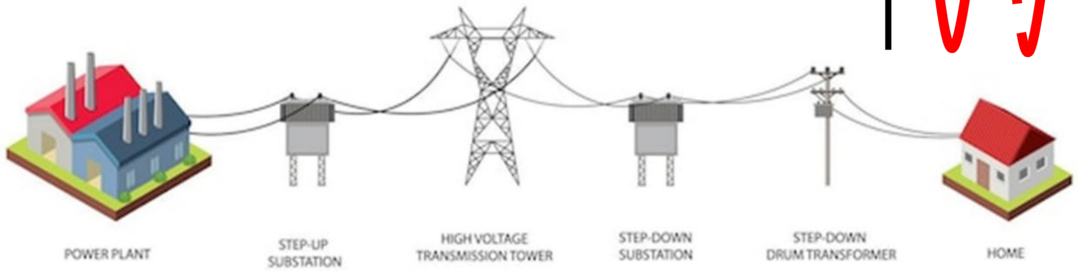
Power		Energy
P=U.I	vs	E=P.t
kW		kWh

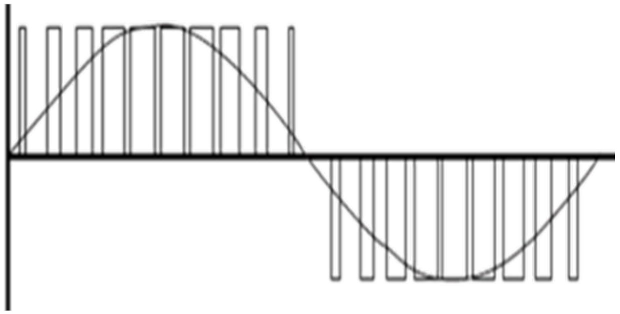


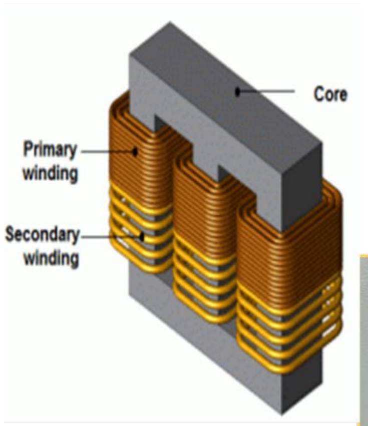
2. Transmission & Distribution

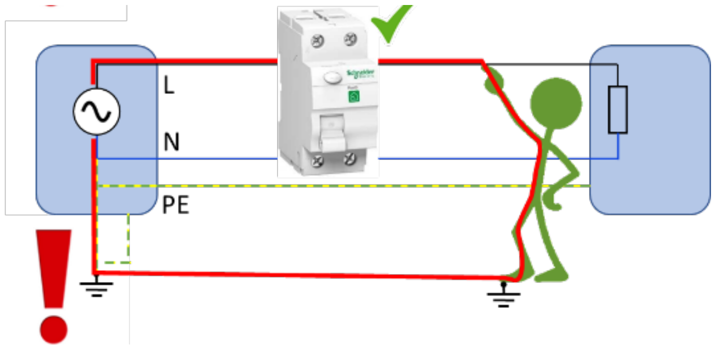
- Energy transport from power plants to consumers
- AC & DC grids
- transformers-convertors
- Power electronics
- Voltage levels, protection







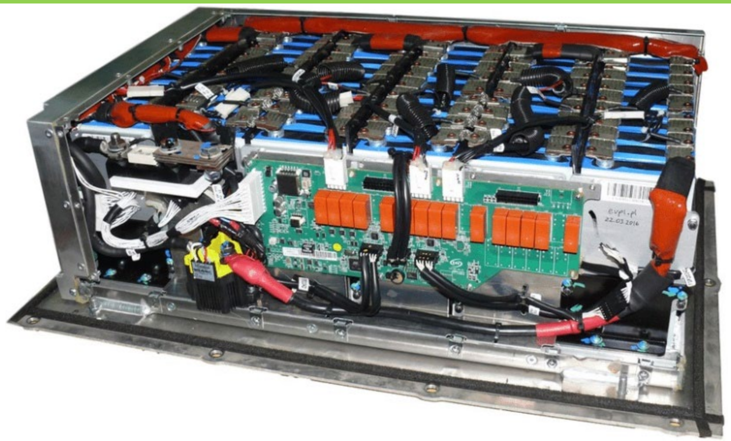


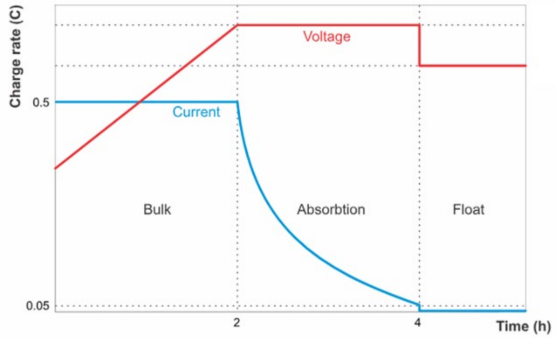


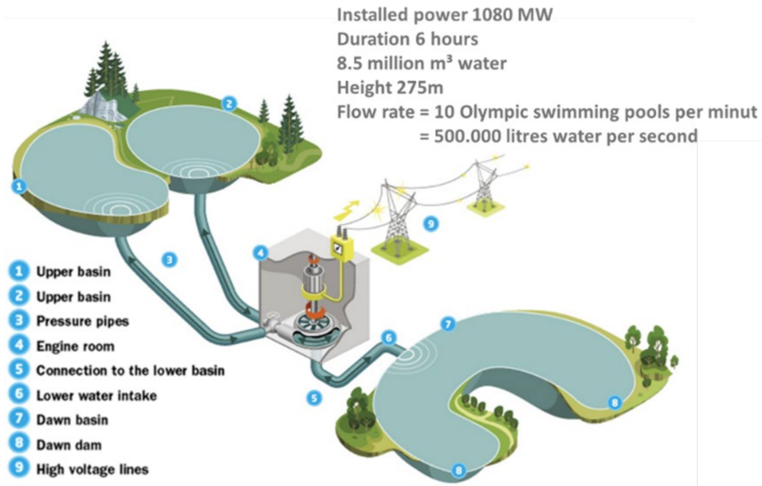
M3 – Network management and storage

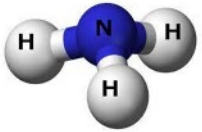
3. Energy Storage Concepts

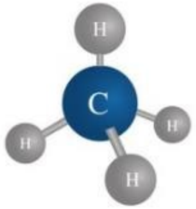
- Electrical batteries : Li-ion, V2G
- Water : pumped hydro
- Mechanical : fly wheels, CAES, . . .
- Heat : geo-thermal, networks, . . .
- Molecules : H_2, NH_3, CH_4,clathrate hydrogen

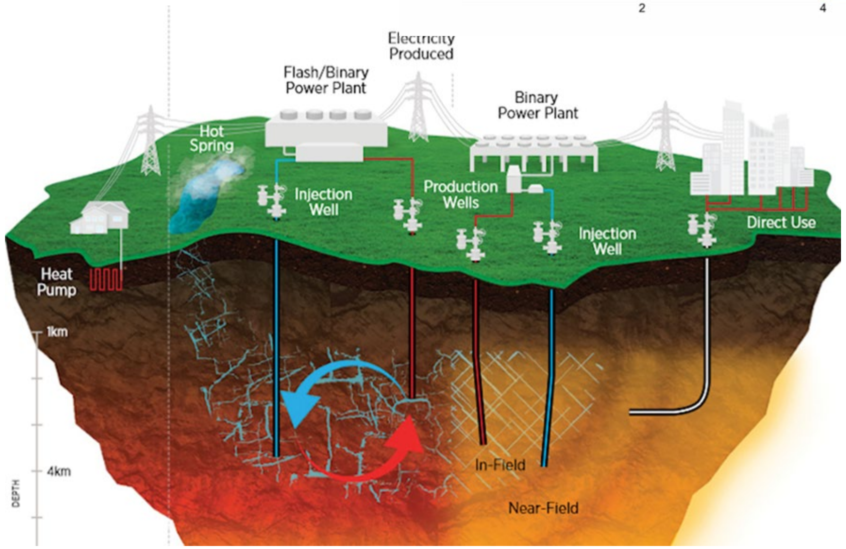






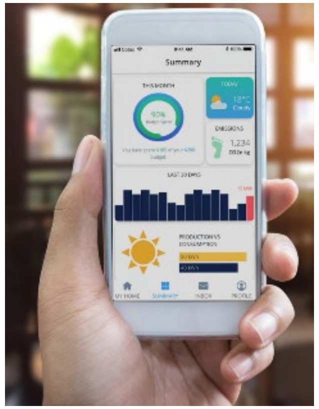


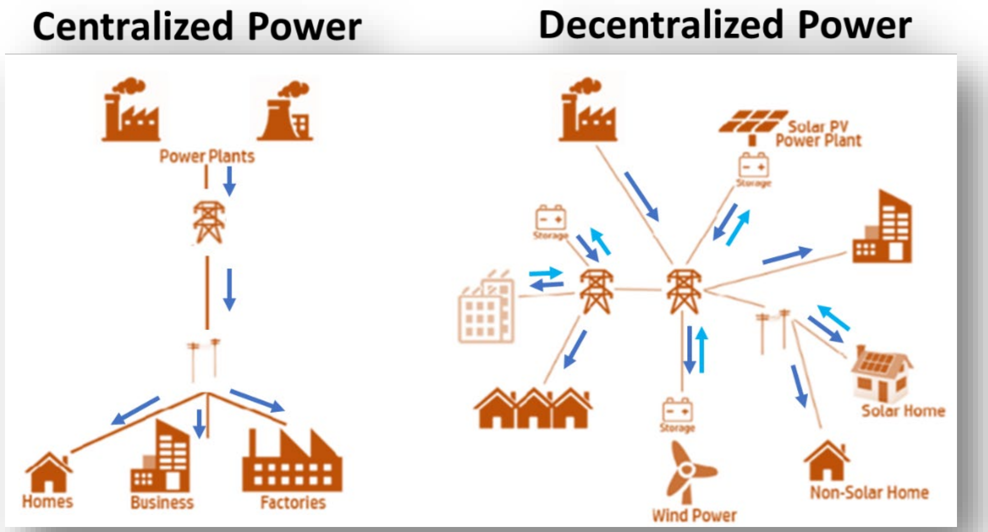


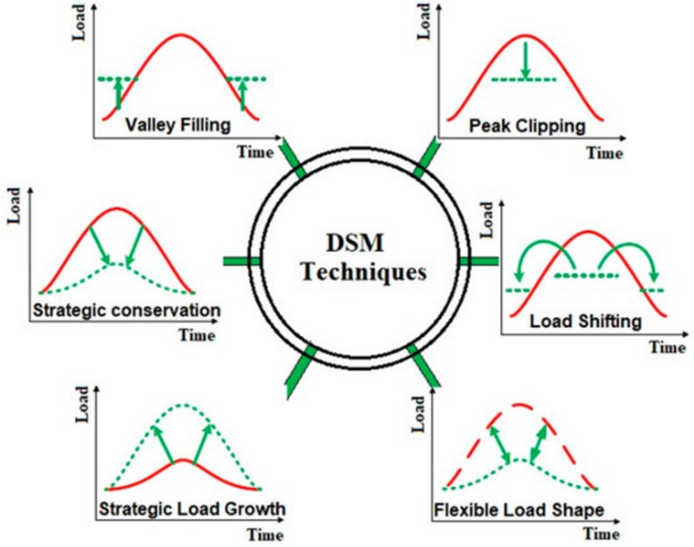


4. Energy Management - EMS

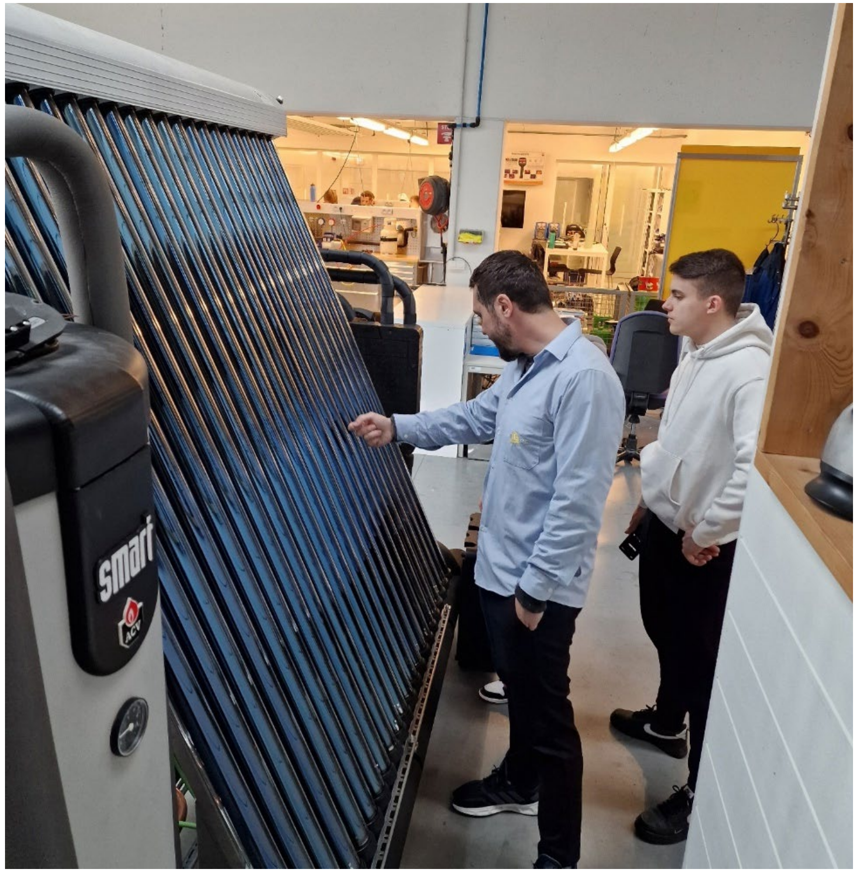
- Power grid, Smartgrid, µGrid
- DSM Demand side mgmt
- SCADA
- VPP Virtual powerplants
- Smart metering
- Pricing €/kWh vs €/kW





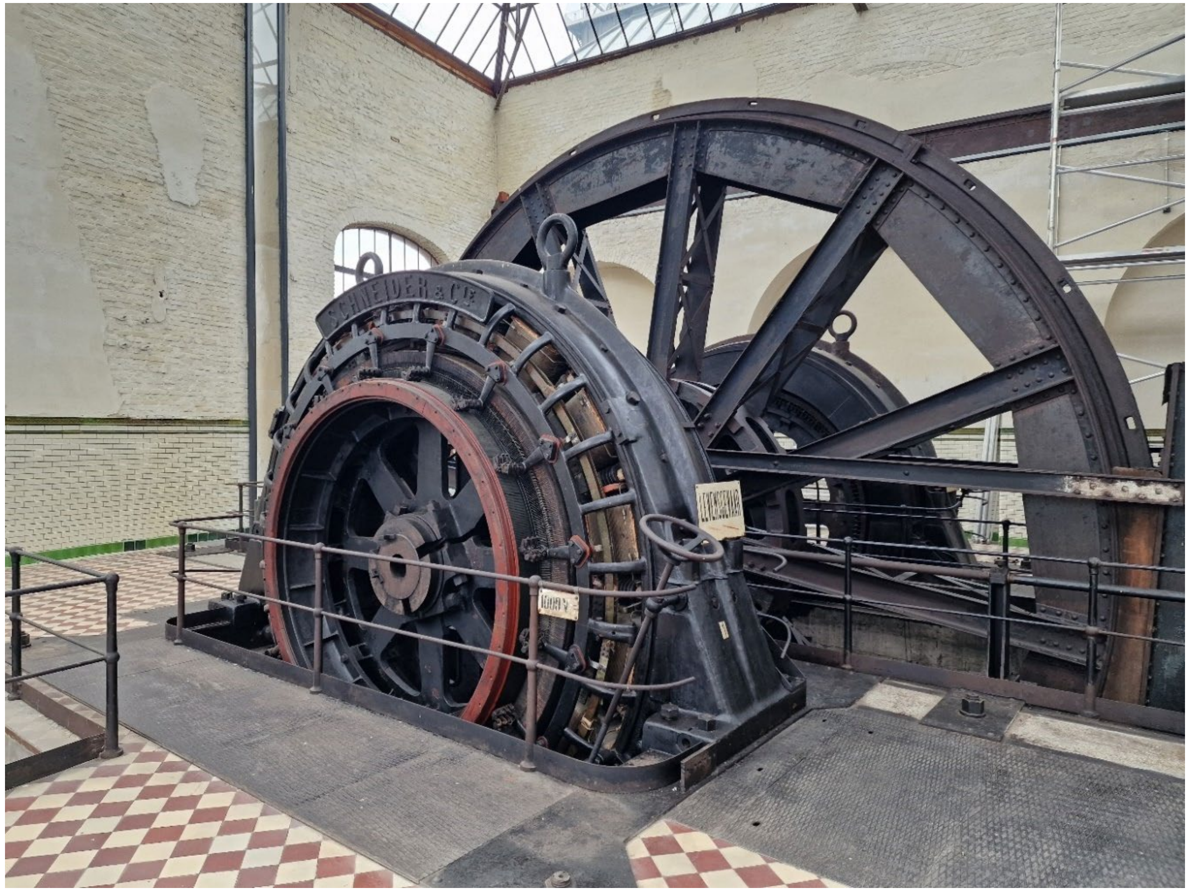


Demo’s, Labs & case study’s – inspiration for teachers



Smart Grid Lab, sun collector

Demo's, Labs & case study's – inspiration for teachers



Heritage, thermal power station

M3 – Network management and storage

Demo’s, Labs & case study’s – inspiration for teachers

Renewable energy sites, hydro, sun, wind

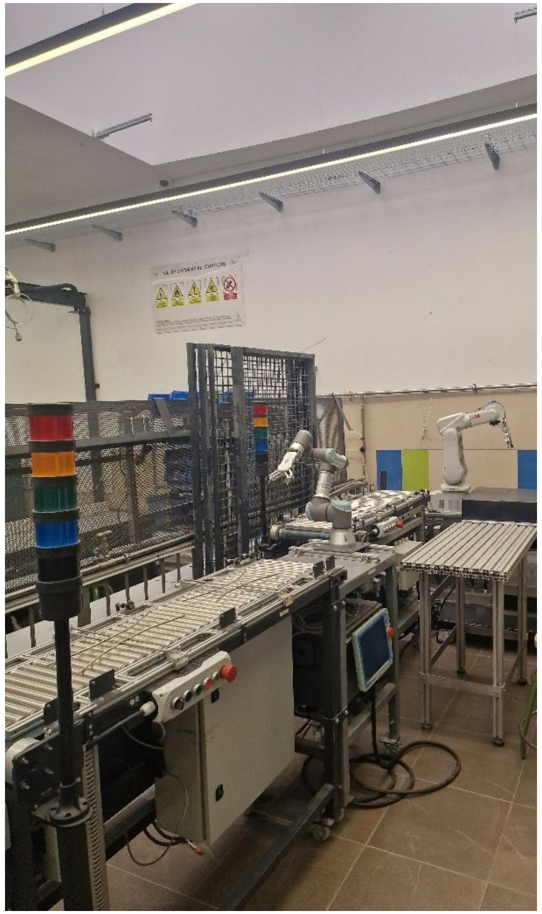
M3 – Network management and storage

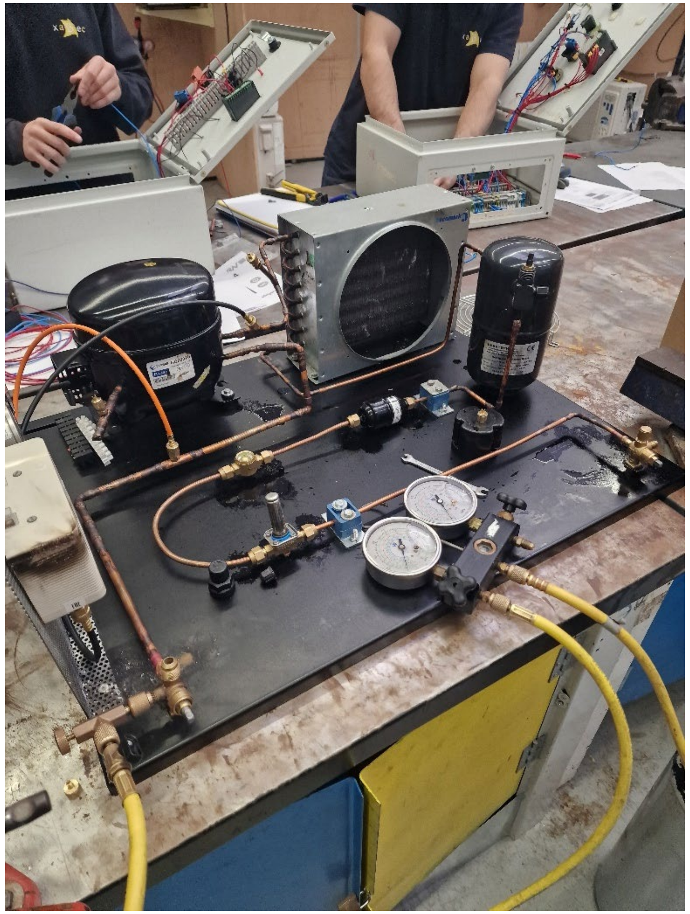
Demo's, Labs & case study's – inspiration for teachers

Substation HV-MV , training centre TSO

M3 – Network management and storage

Demo’s, Labs & case study’s – inspiration for teachers





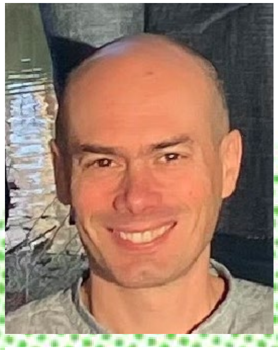
Teaching activities, labs

Demo’s, Labs & case study’s – inspiration for teachers

Field installations, cooling system

GreenTech project – Module 4
Hydrogen green production

Credit: McPphy



Cyril PICARD

Content of the module

I. Hydrogen: current status

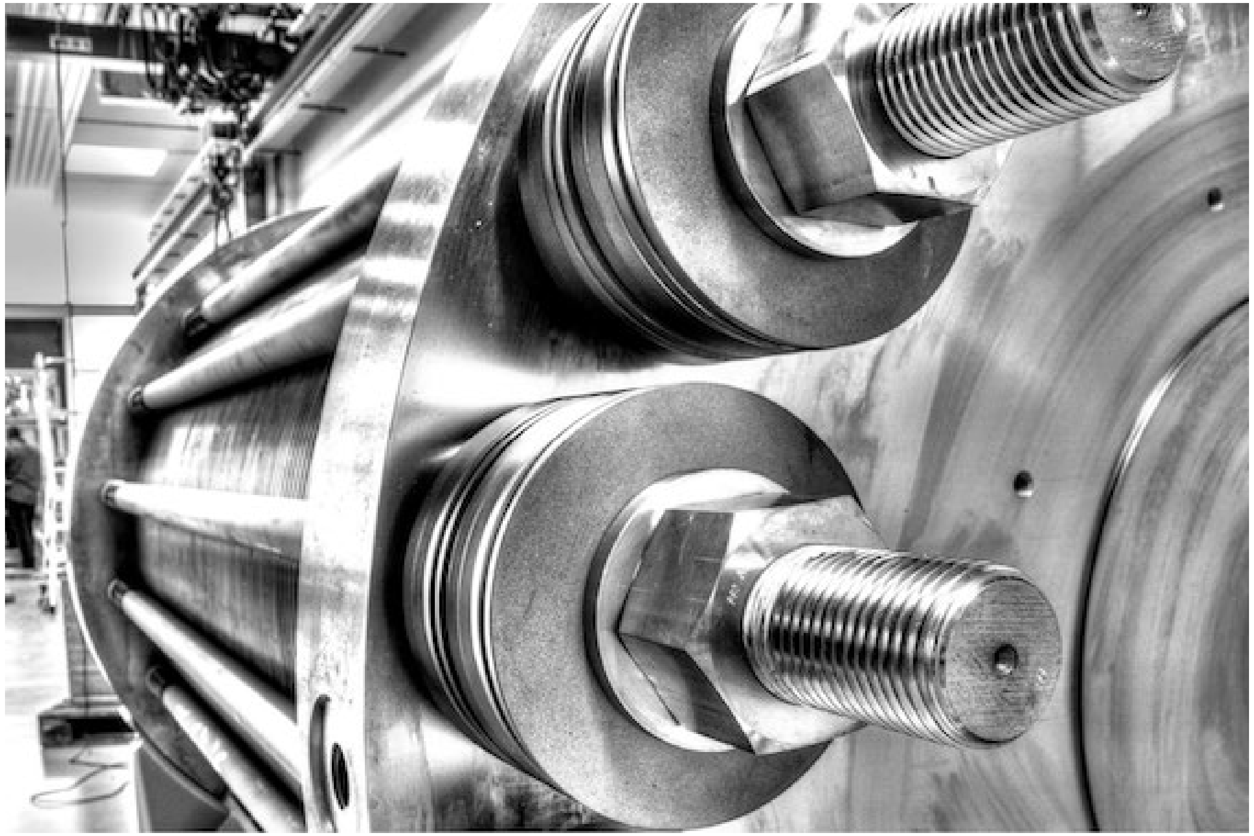
II. H_2 to face carbon emissions

III. Electrolysers for H_2 production

IV. Hydrogen storage

V. Some theory as scaling tools

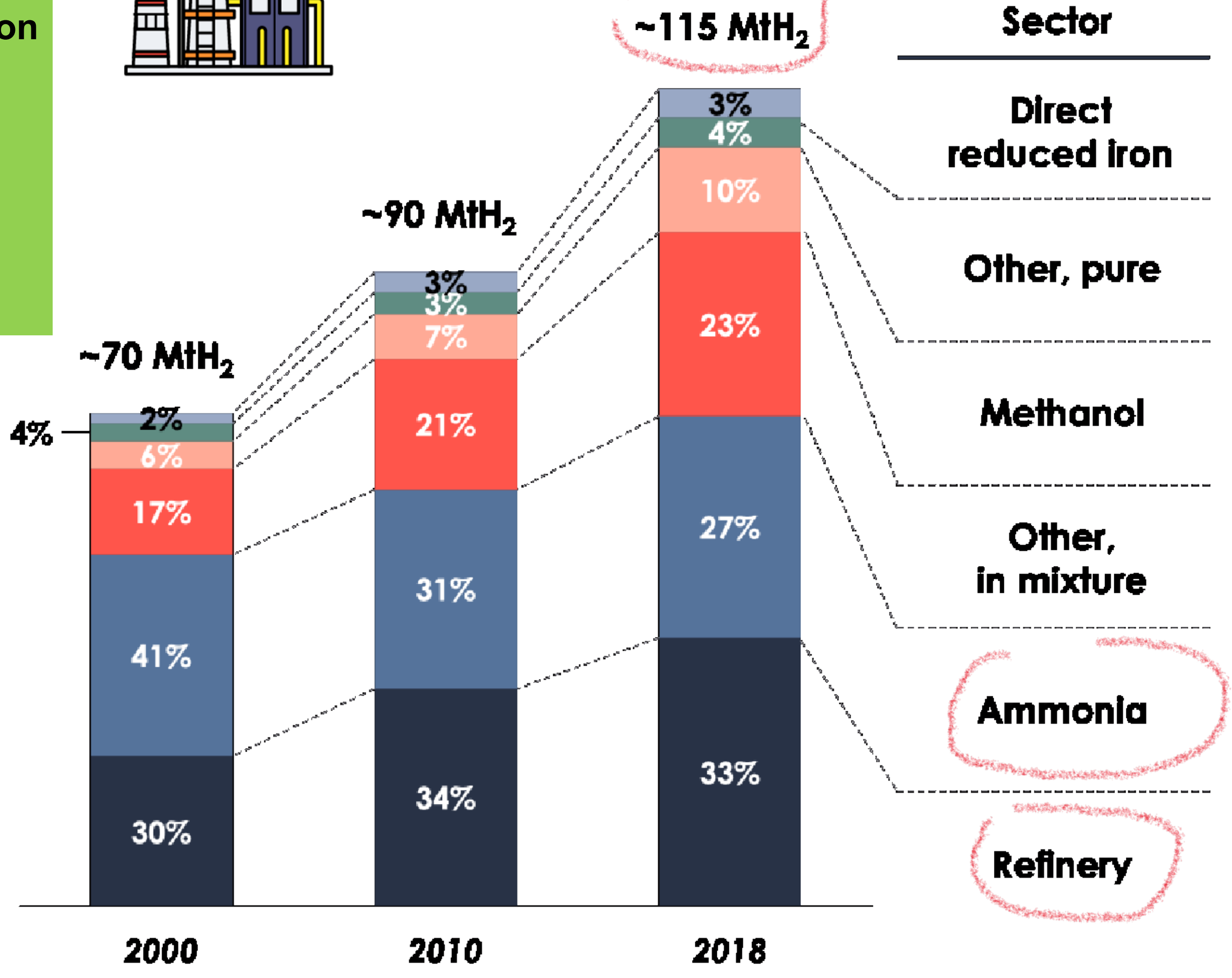
VI. Risks and safety rules



Hydrogen: current industrial status

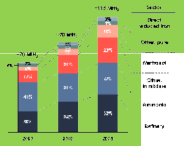
$$CH_4 + 2H_2O \rightarrow CO_2 + 4\,H_2$$

Essentially for chemistry



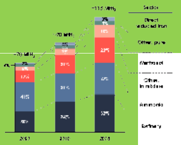
In Europe Hydrogen is essentially used for ammonia production and oil refiney

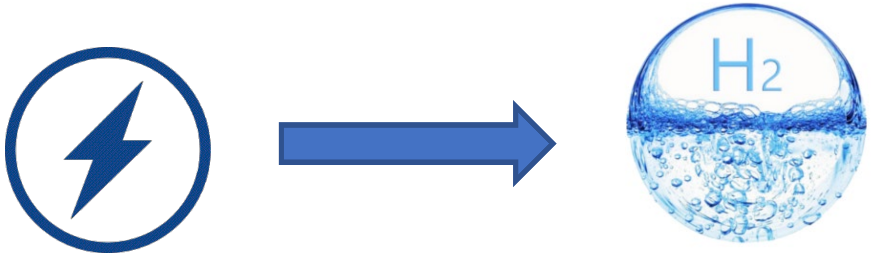
H2 to face carbon emissions



$$CH_4 + 2H_2O \rightarrow CO_2 + 4\,H_2$$

H2 to face carbon emissions





Par ailleurs, la société Norsk Hydro, premier constructeur et utilisateur d'électrolyseurs à eau au niveau mondial, présente en 1980 à EDF un projet d'unité de 300 MW, dérivé de ses unités existantes.

En 1984, le meilleur fonctionnement de ses pilotes, d'abord de 10 puis de 30 kW, fait pencher le choix sur le groupe ACB-LDM, auquel la commande d'un pilote de 2,4 MW est passée, qui incorpore toutes les options retenues par le constructeur, à savoir :

— enceinte pressurisée à 30 bars ;

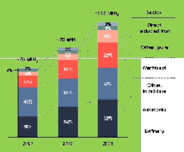
— module type d'électrolyse de 2,4 MW à électrodes de nickel avec nickel fritté activé, de 1 m × 1 m ;

— cellules minces d'épaisseur de 5 mm ;

— électrolyse de la potasse à 40 %, à 120°, sous 10 kA/m^2.

Pour des raisons pratiques d'exploitation et d'utilisation de l'hydrogène, le site d'implantation retenu pour le pilote est la plate-forme chimique de Rhône-Poulenc de Pont-de-Claix, près de Grenoble.

H2 to face carbon emissions



I. Hydrogen: current status

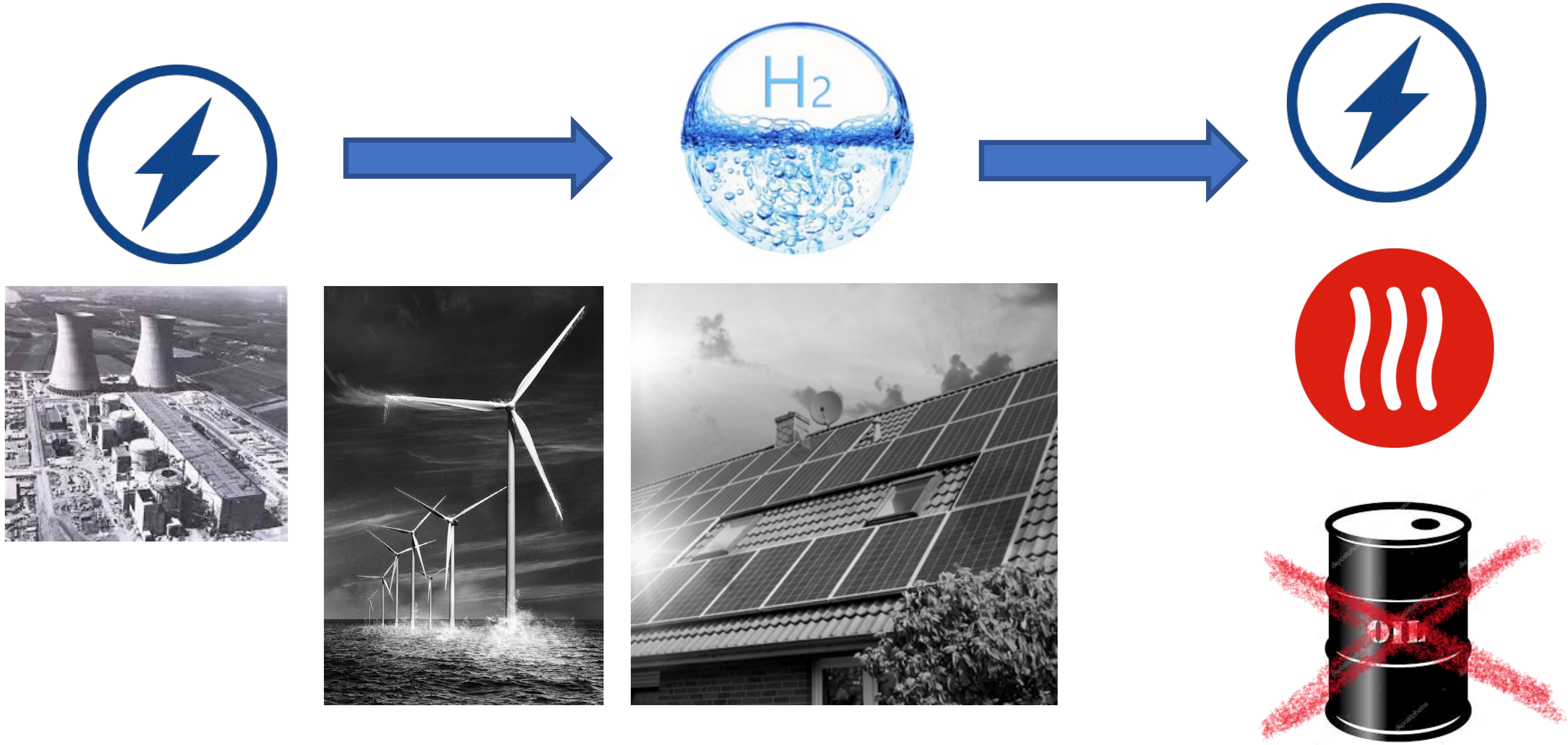
II. H_2 to face carbon emissions

III. Electrolysers for H_2 production

IV. Hydrogen storage

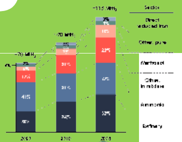
V. Some theory as scaling tools

VI. Risks and safety rules

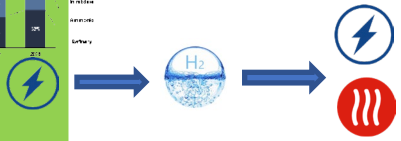


Electrolysers for H_2 production

I. Hydrogen: current status



II. H_2 to face carbon emissions

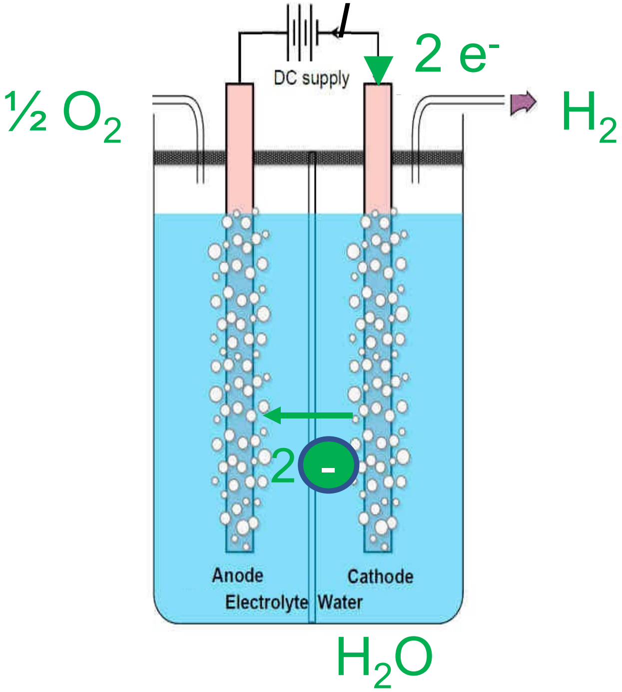


III. Electrolysers for H_2 production

IV. Hydrogen storage

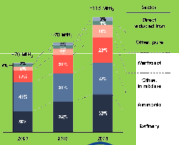
V. Some theory as scaling tools

VI. Risks and safety rules

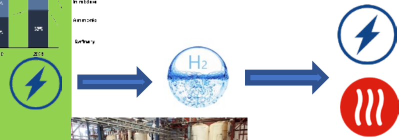


Hydrogen storage

I. Hydrogen: current status



II. H_2 to face carbon emissions

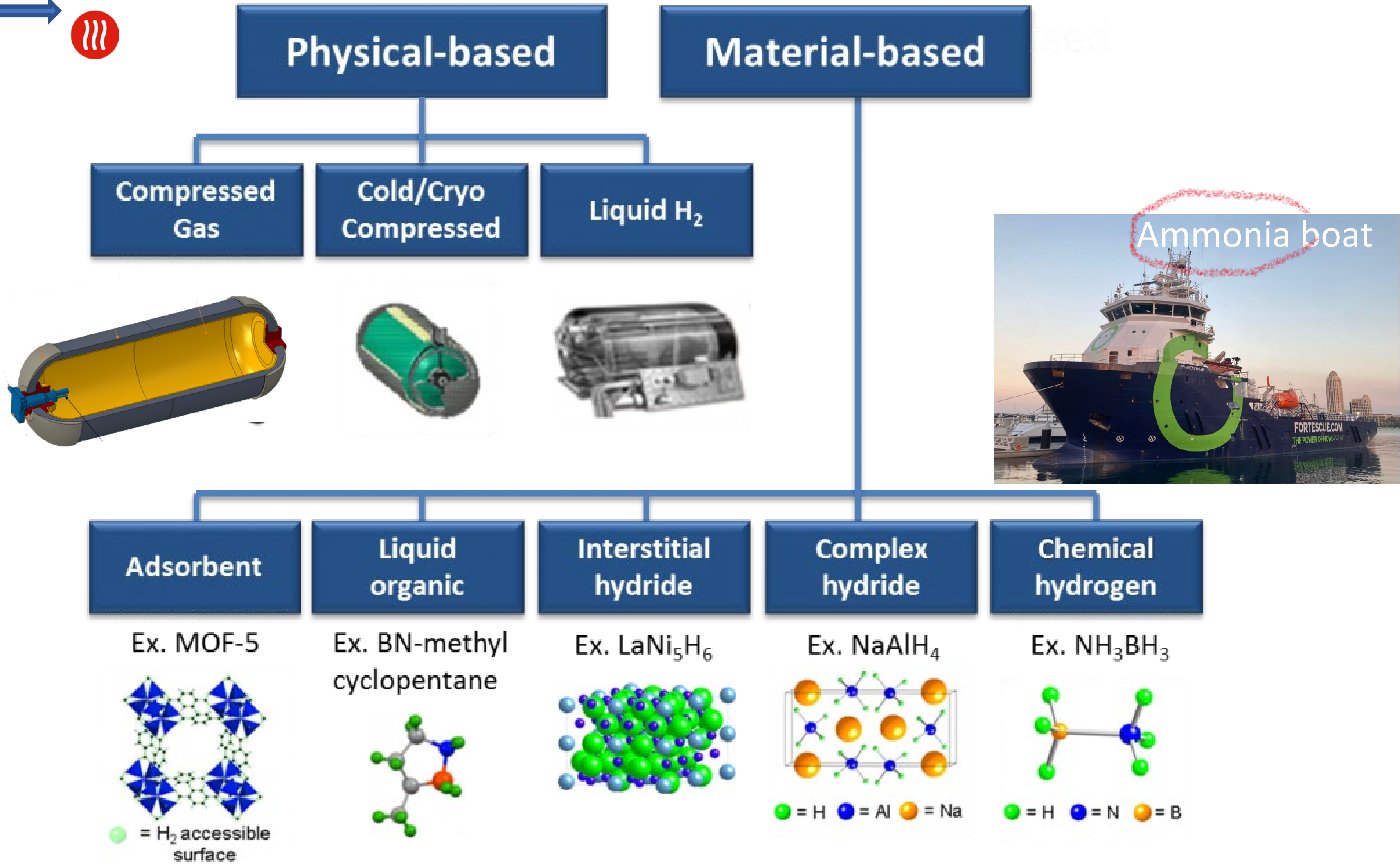


III. Electrolysers for H_2 production

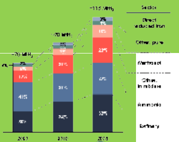
IV. Hydrogen storage

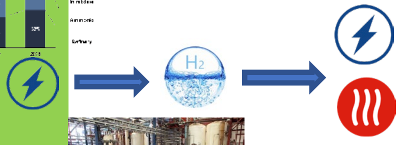
V. Some theory as scaling tools

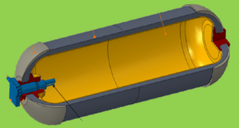
VI. Risks and safety rules

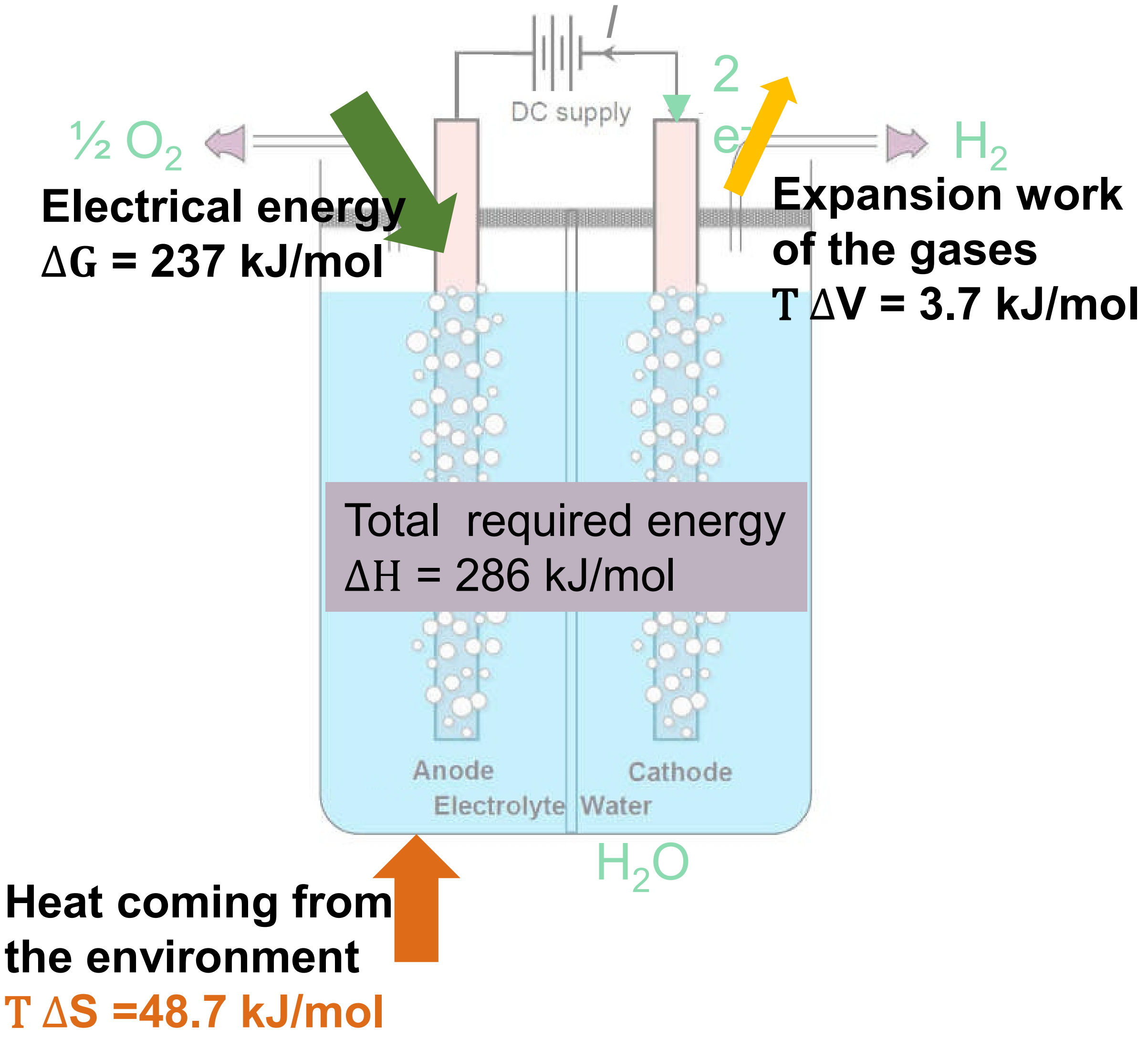


Some theory as scaling tools



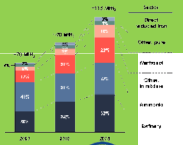




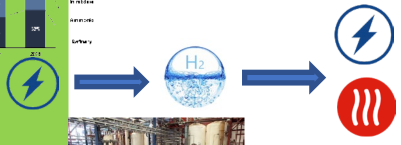


Risks and safety rules

I. Hydrogen: current status

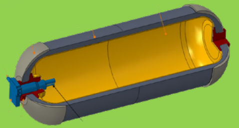


II. H_2 to face carbon emissions



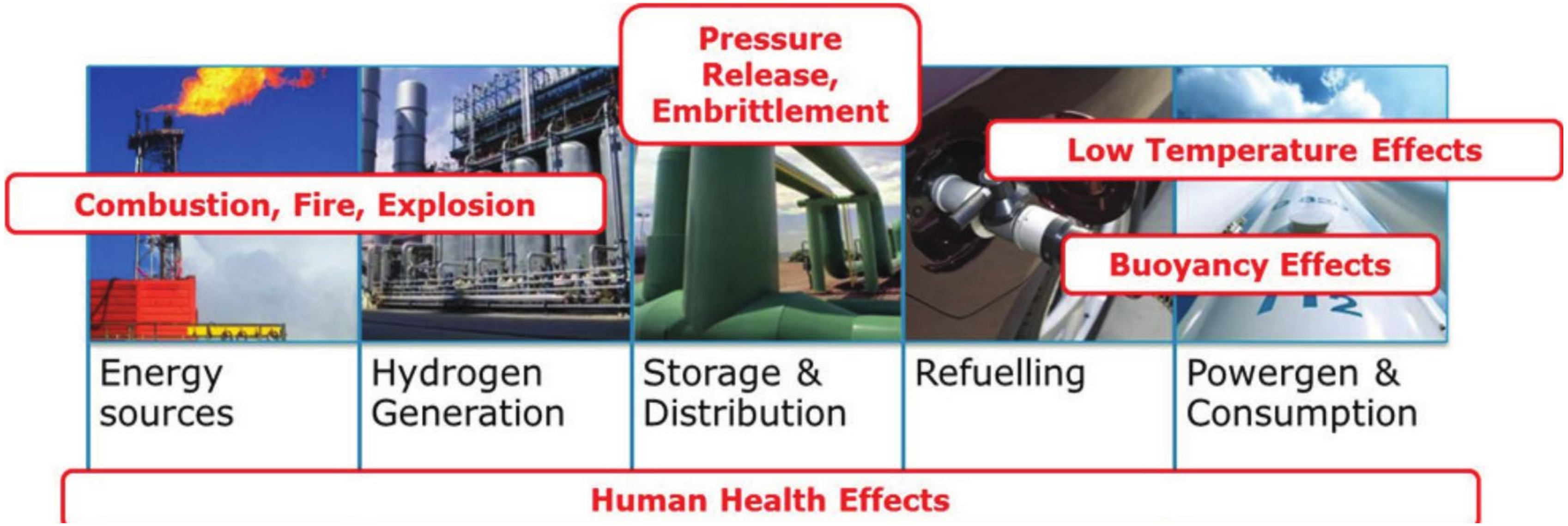
III. Electrolysers for H_2 production

IV. Hydrogen storage



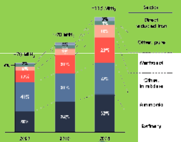
V. Some theory as scaling tools

VI. Risks and safety rules

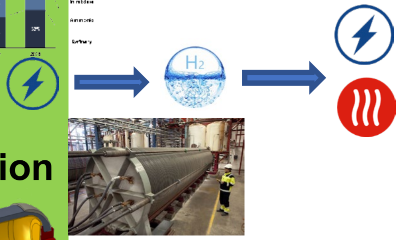


From the classroom to the lab

I. Hydrogen: current status

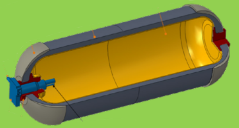


II. H_2 to face carbon emissions



III. Electrolysers for H_2 production

IV. Hydrogen storage

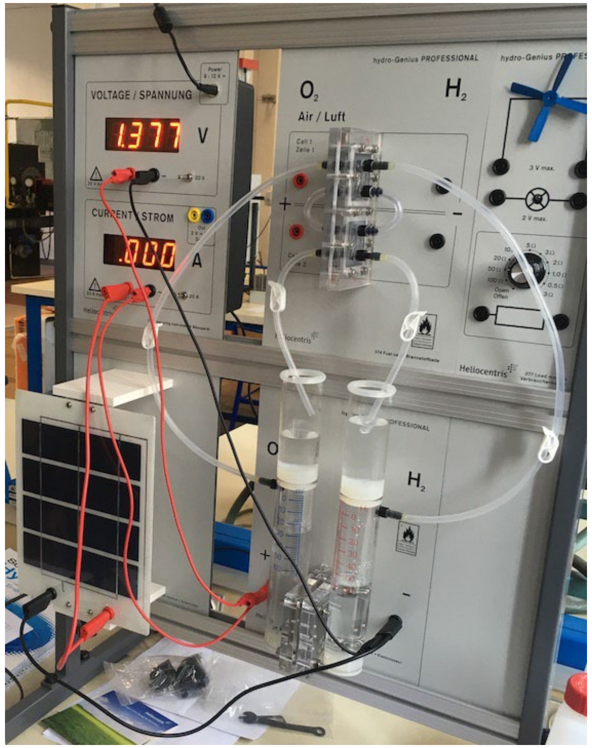


V. Some theory as scaling tools

VI. Risks and safety rules

10h in classroom

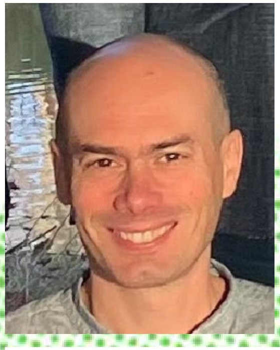
+ 8h of practicals at UGA



H_2 value chain
UGA, France

Basics of electrolysis
Panko - Lituania

GreenTech project – Module 5
Energy usage



Cyril PICARD

Content of the module

I. Energy value chains

II. Raw material for the energy

III. Final uses of energy

IV. Energy transfers

V. VI. Power from low-carbon fuels

VII. Energy challenge

Energy value chains: present and future

I. Energy value chains

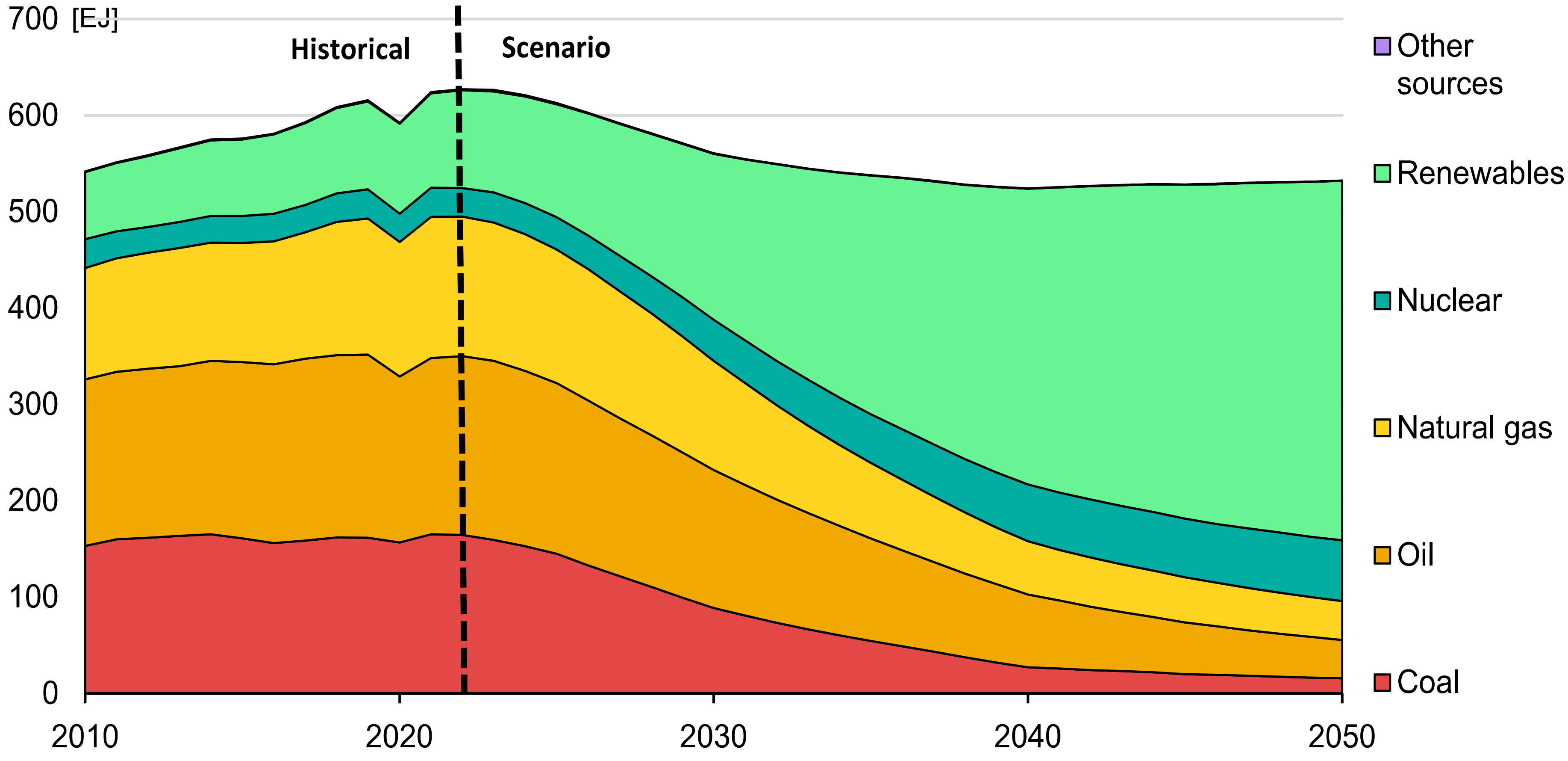
II. Raw material for the energy

III. Final uses of energy

IV. Energy transfers

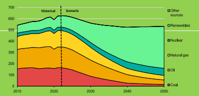
V. VI. Power from low-carbon fuels

VII. Energy challenge



Raw material for the energy

I. Energy value chains



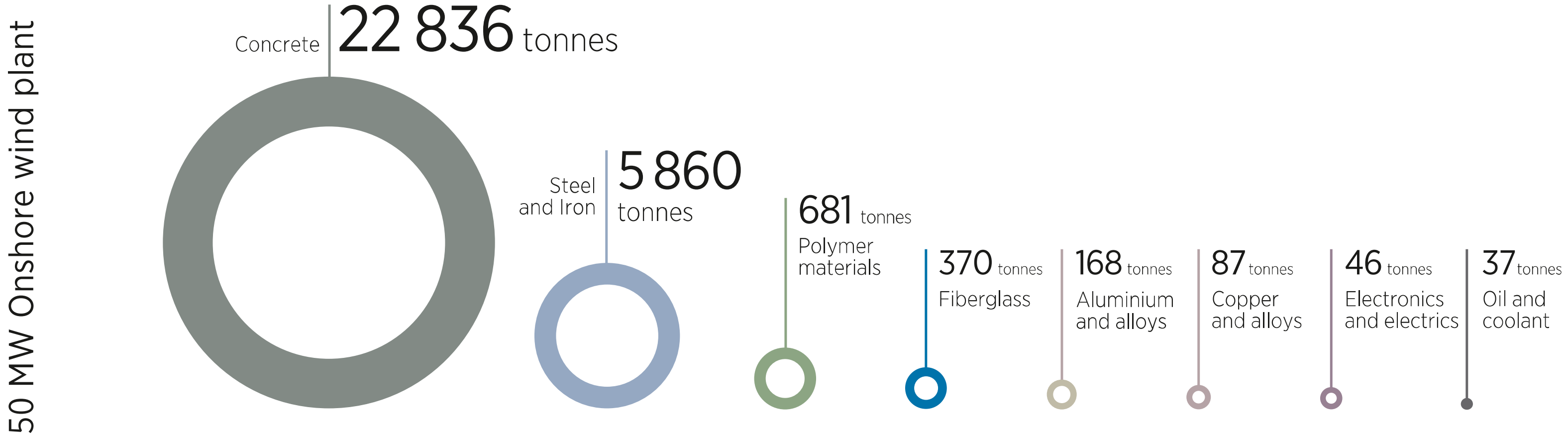
II. Raw material for the energy

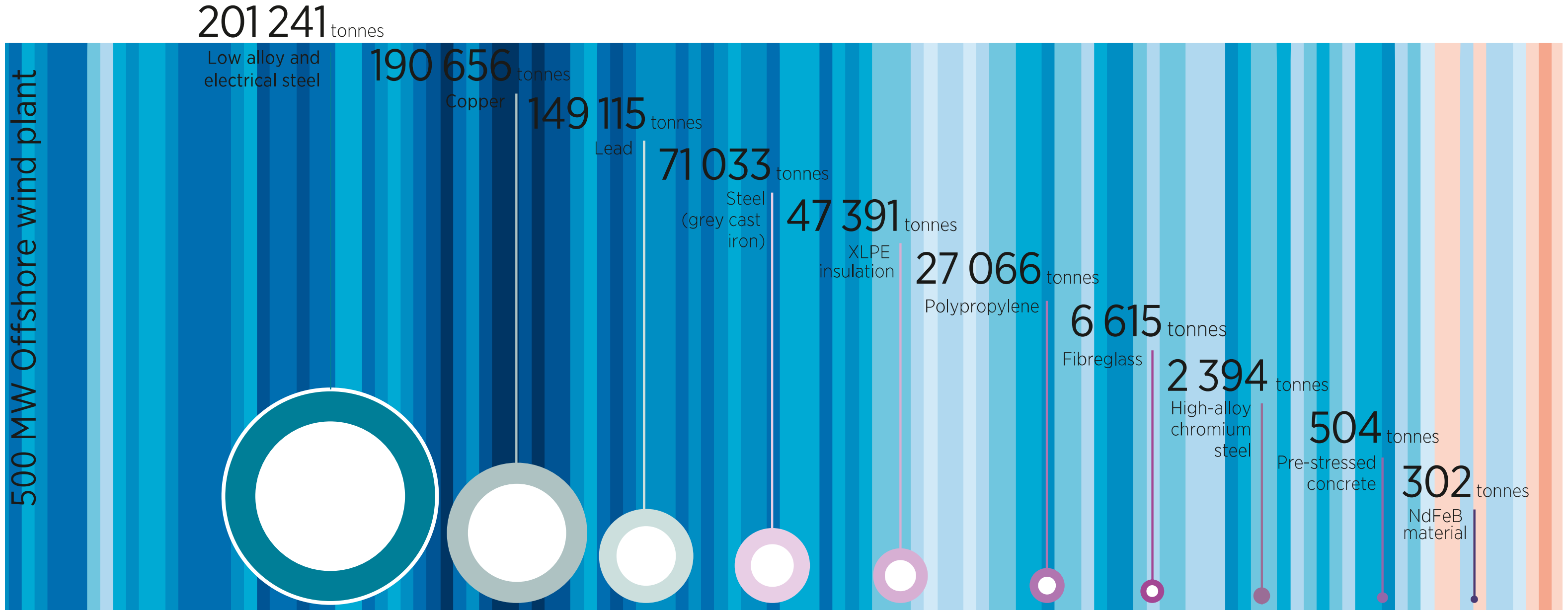
III. Final uses of energy

IV. Energy transfers

V. VI. Power from low-carbon fuels

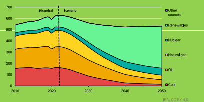
VII. Energy challenge



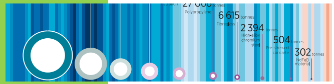


Final uses of energy

I. Energy value chains



II. Raw material for the energy

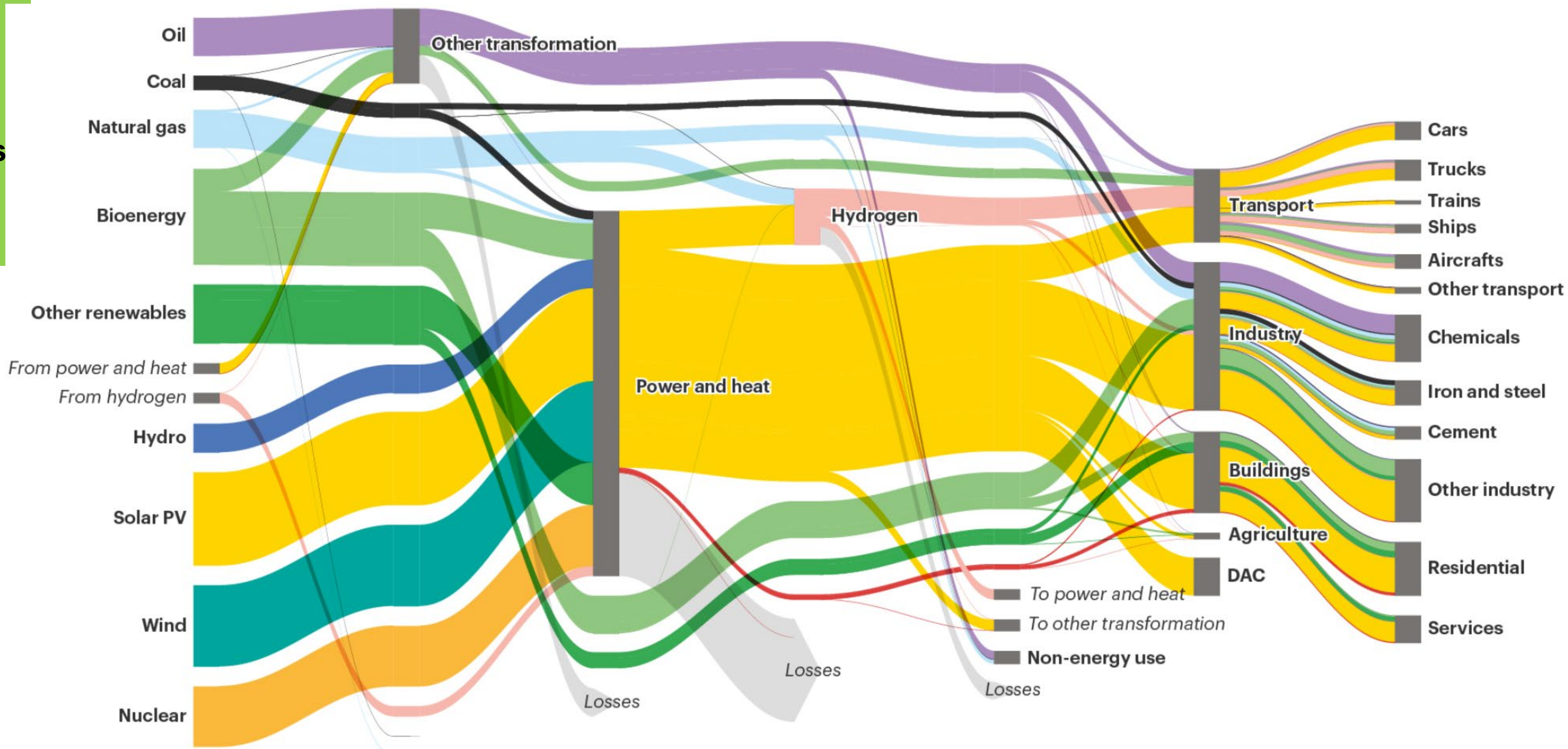


III. Final uses of energy

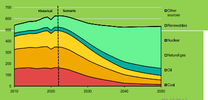
IV. Energy transfers

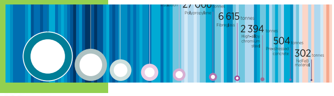
V. VI. Power from low-carbon fuels

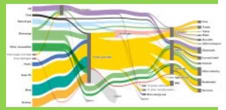
VII. Energy challenge



Energy transfers

I. Energy value chains 

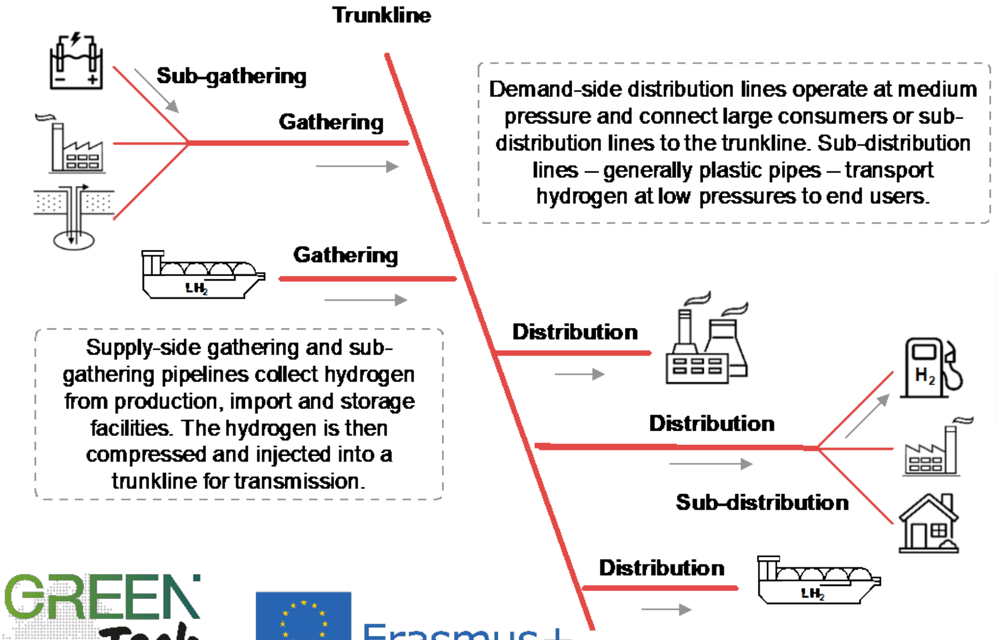
II. Raw material for the energy 

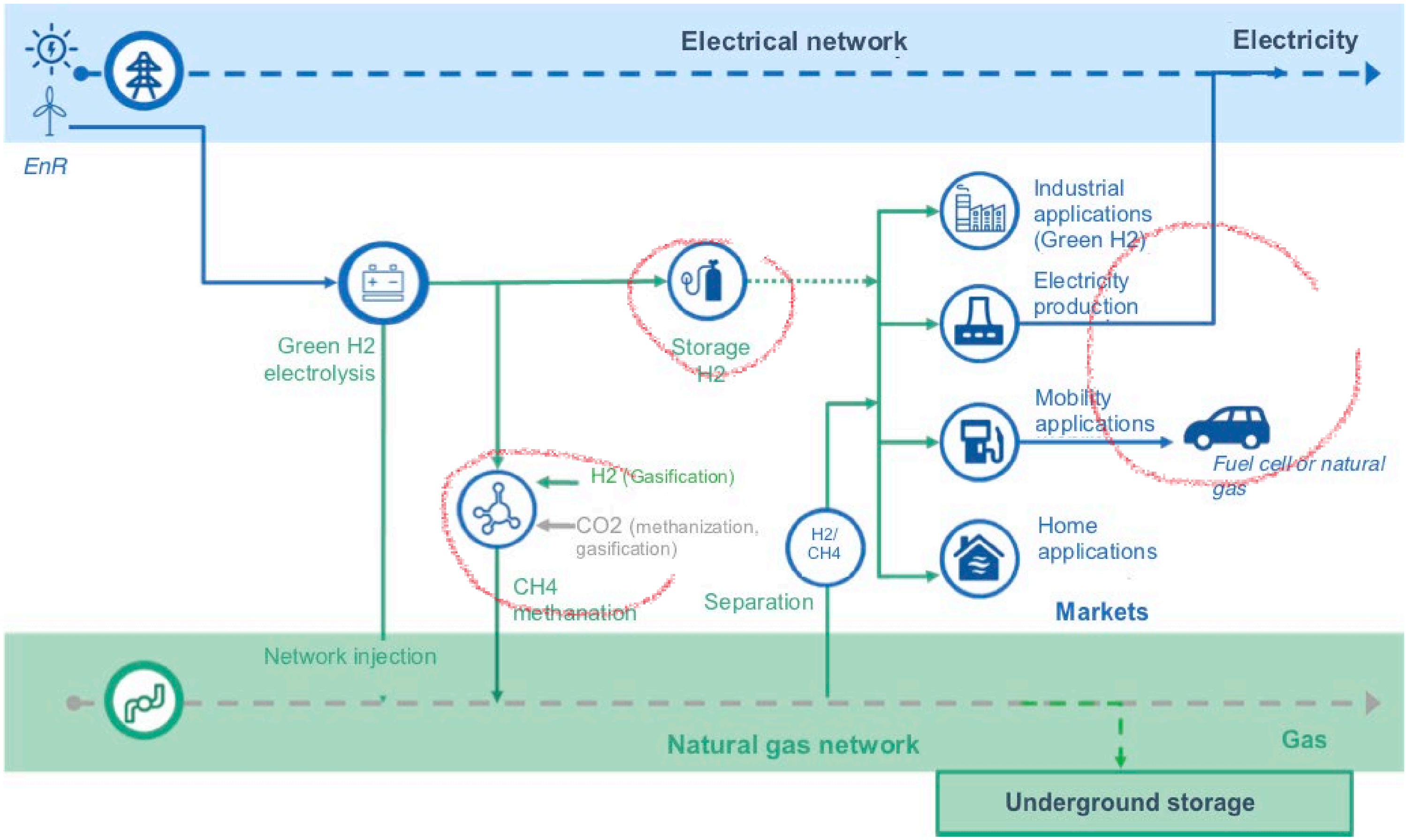
III. Final uses of energy 

IV. Energy transfers

V. VI. Power from low-carbon fuels

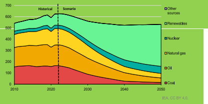
VII. Energy challenge



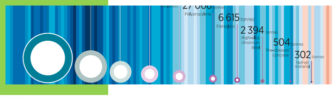


Power from low-carbon fuels

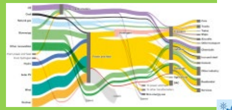
I. Energy value chains



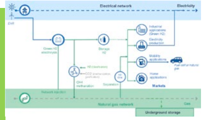
II. Raw material for the energy



III. Final uses of energy



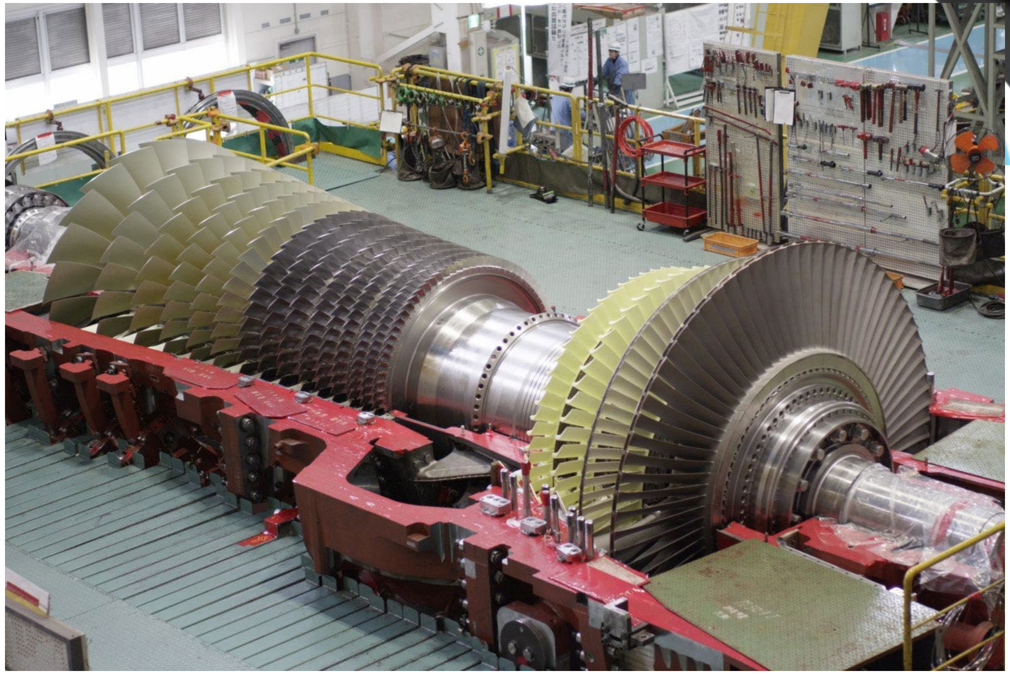
IV. Energy transfers

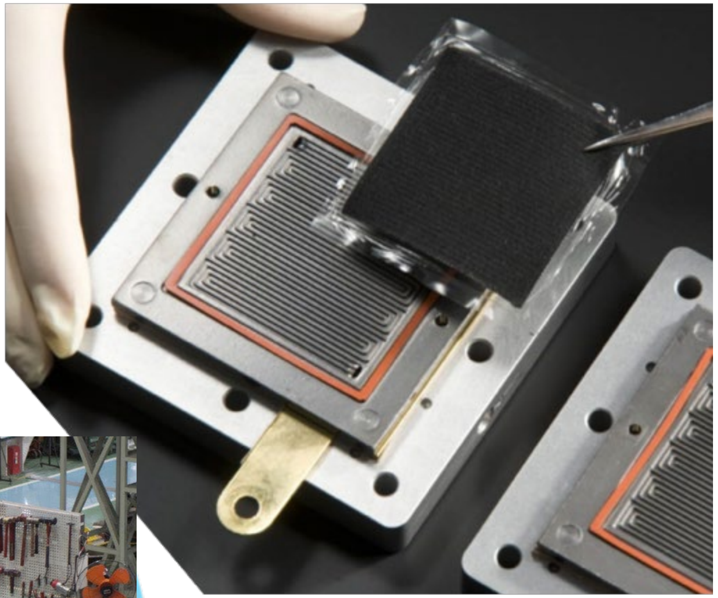


V. VI. Power from low-carbon fuels

VII. Energy challenge

Heat engines



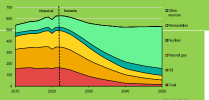


Fuel cell

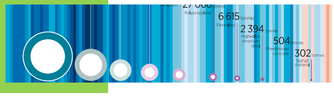
Erasmus+

Energy a multi-criteria challenge

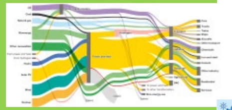
I. Energy value chains



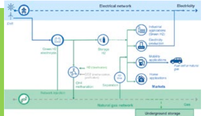
II. Raw material for the energy



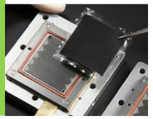
III. Final uses of energy



IV. Energy transfers



V. VI. Power from low-carbon fuels



VII. Energy challenge

Natural resources

Sufficiency

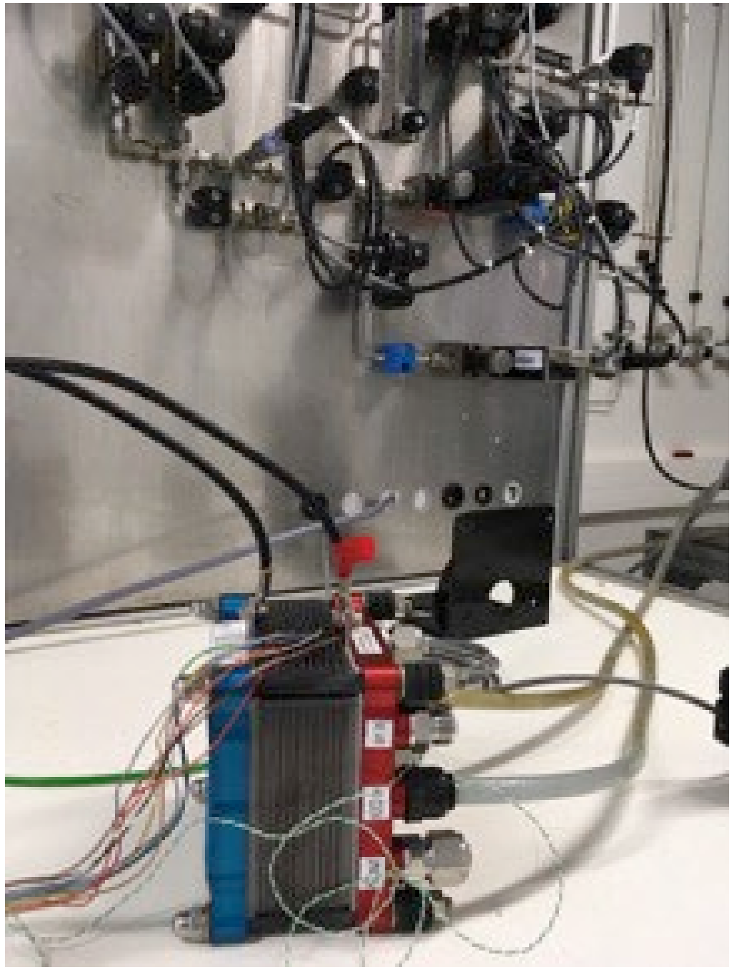
Financial ressources

Human resources

Economy

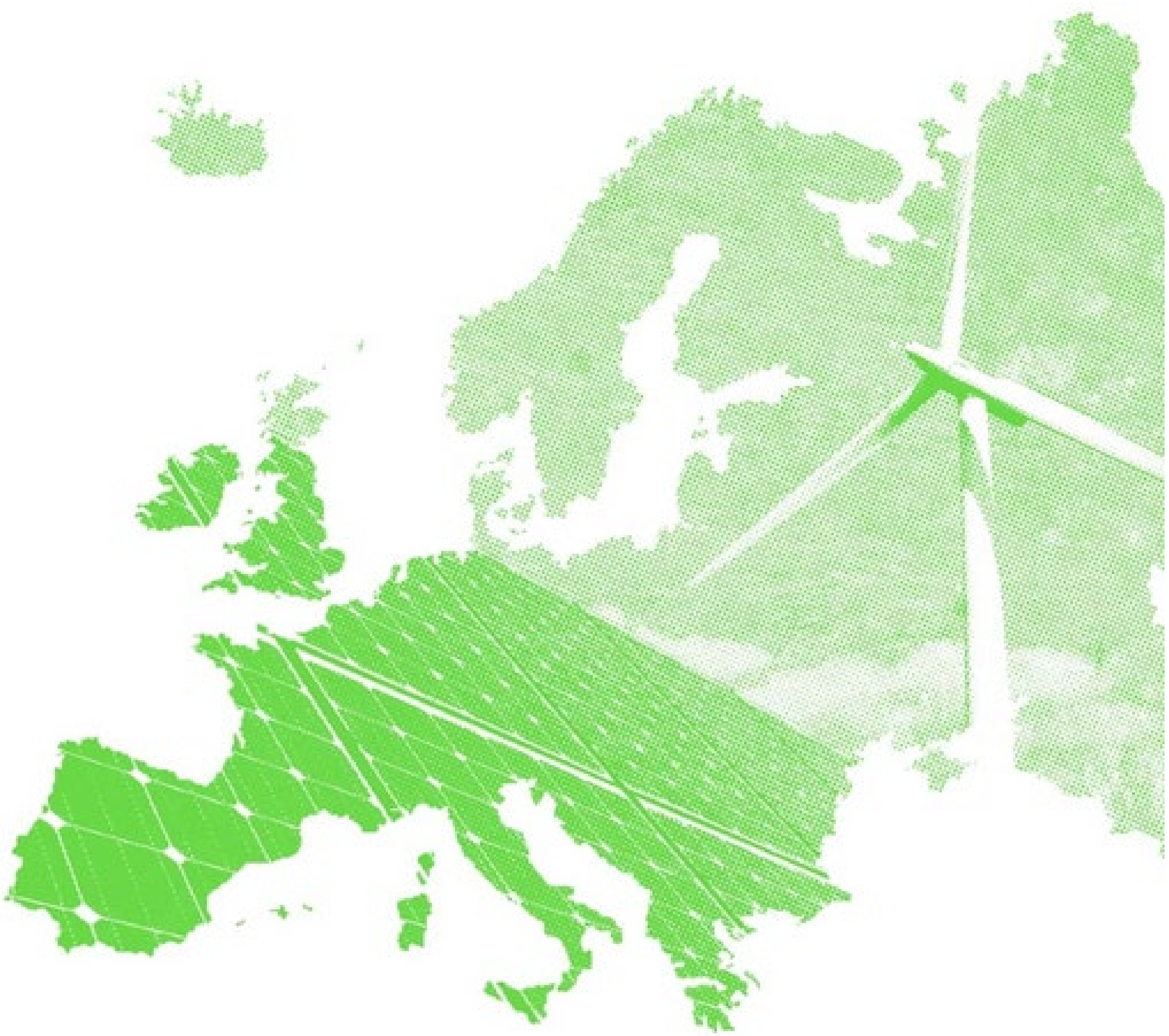
Geopolitics

Lab work on the balance of plant of a fuel cell system



Erasmus+

First results and lessons learnt



MOOC

- **95 participants** have followed the first session of the MOOC
- **8** countries represented
- **20 people** completed a module and obtained **at least one badge**
- **11 people** completed **all the modules**

- <u>Per module:</u>

Introductory module : 16 people obtained the badge
Solar energy : 17 people obtained the badge
Wind energy : 17 people obtained the badge
Network management and storage : 12 people obtained the badge
Green hydrogen production : 14 people obtained the badge
Usages : 14 people obtained the badge

- <u>Content evaluation of the modules :</u>

- All the modules were much appreciated and very well evaluated (77% with a score between 4 and 5 (on a scale of 1 to 5))
- The course slides were excellent supplements
- The “Descriptive sheet” files was useful as a preamble to the modules to help understand their objectives
- 80% of participants felt that the teaching objectives of the modules had been met

Project feedback / lessons learnt

The report is available on the GreenTech website : https://greentech-erasmus.eu

- 548 students benefited from the test sessions (218 students for local training sessions / 330 students for training sessions in partner institution)
- 75% of students followed the courses with interest

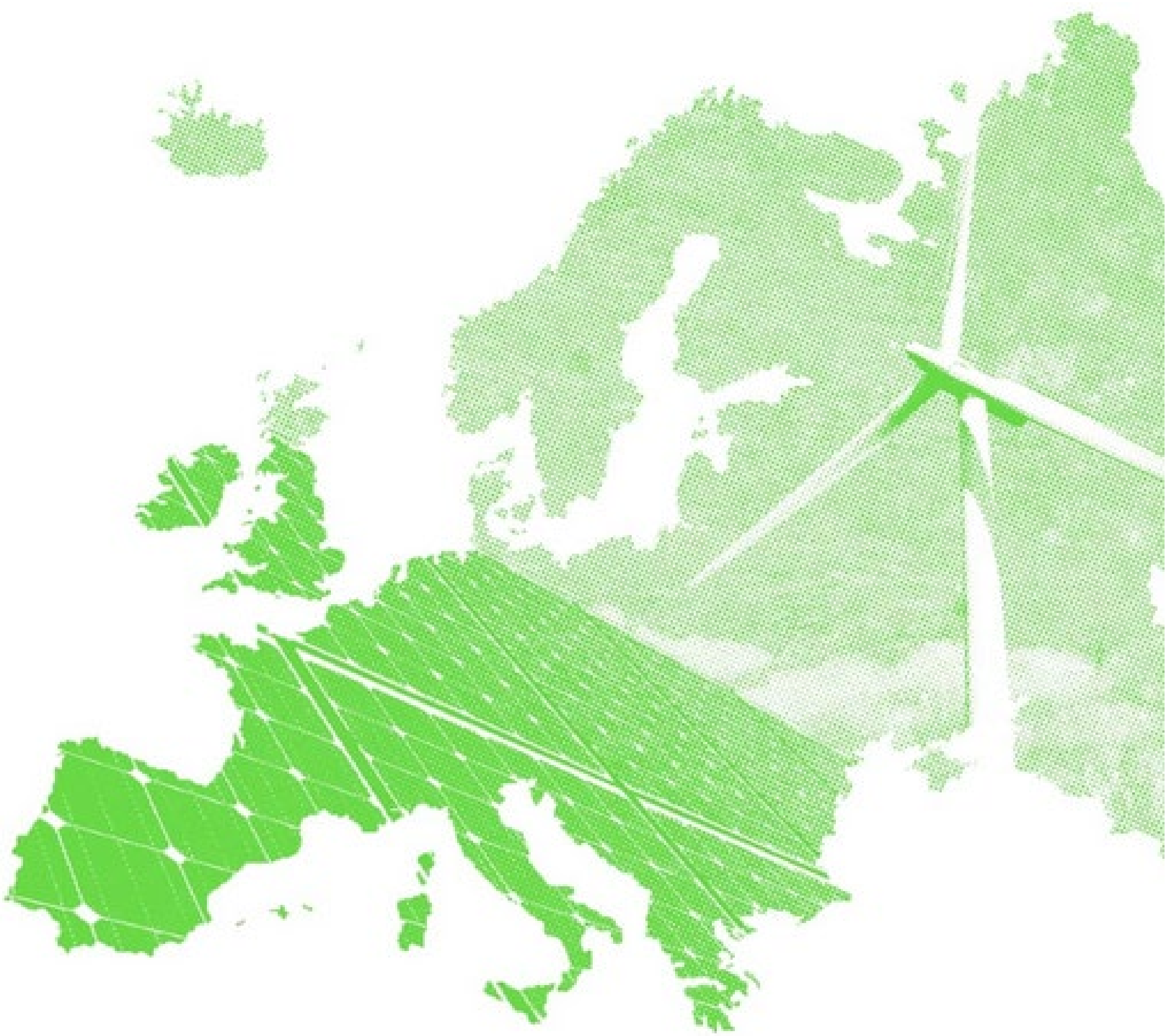
What's working well?

- Long-term sustainability of the project and reinvestment > the courses were integrated into the students' training programs.
- The teachers were much appreciated and listened to the needs of their students.
- A small number of students to create good teaching and learning conditions :
- Good results of the knowledge tests : 73% of students' answers were correct

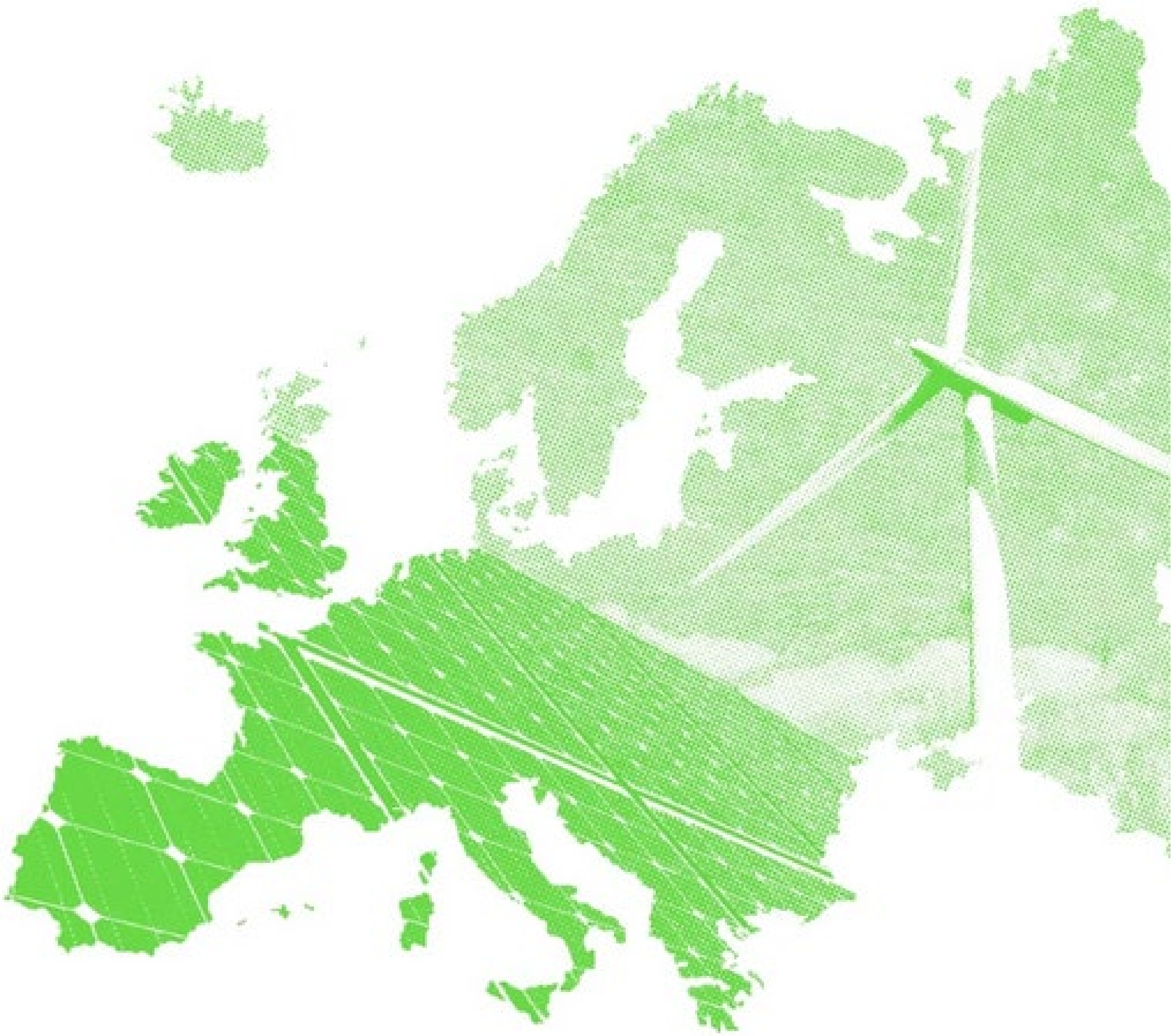
What could be improved?

- It would be interesting to clearly indicate the necessary prerequisites at the start of each module.
- Divide the content of the modules into several sub-sections, associated with different levels of competence.
- Deliver courses in English rather than in the language of the teachers’ country (work on the scientific and technical vocabulary of the modules).
- Difficulties in transposing practical sessions: using professional software for case studies is a good solution

Questions & Answers



Perspectives



Perspectives

- Deliverables availability and dissemination : CMQe SES / GIP website
- MOOC
  - Will remain open on Caseine (Université Grenoble Alpes)
  - New session(s) ?
- IUT1 : will continue the exchanges with GreenTech partners to teach 1 or severals modules to BUT3 students → Erasmus mobilities
- Elibrary started by ETF (European Training Foundation)
- Links with the COVE Project P4ELECS
- Ex-GreenTech Team → meeting in a few months
- **Perspectives from the audience ?**

SPEED MEETINGS

(S2)

NETWORKING